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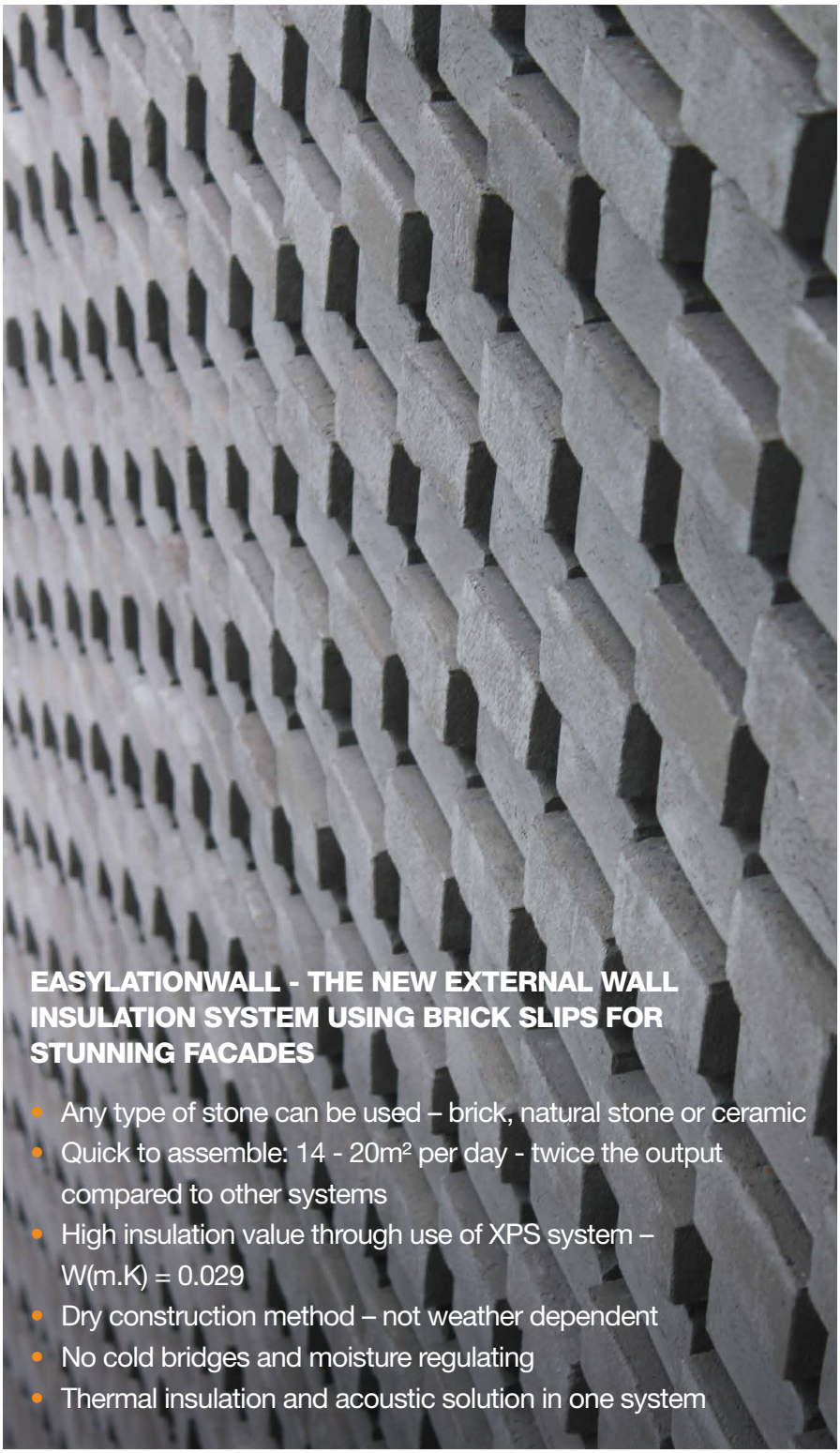
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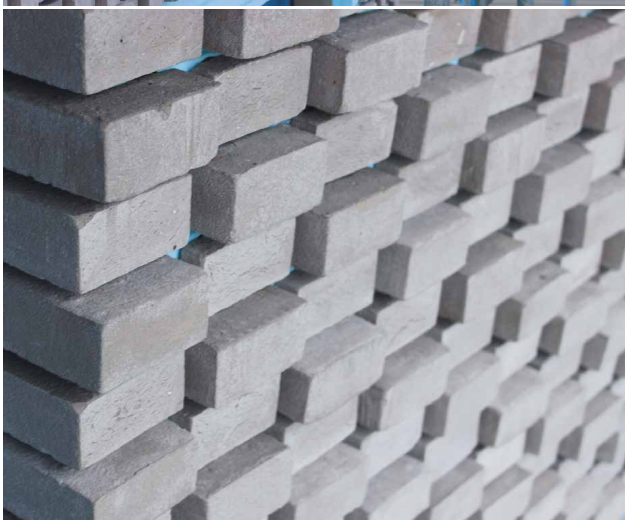
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editor's letter

Modern life, it seems, is increasingly confronting us with impending or current crises and full-blown emergencies. Perhaps the insatiable need of the 24 hour news cycle is partly to blame for fanning the flames, but whether it's the threat of terrorist brutality, global economic collapse, escalating homelessness, disease or runaway global warming, it's reached the stage where the only way to avoid an uninvited dose of impending doom is to disconnect and lie down in a dark room.

While it tends not to generate the same media profile as more news-friendly items, the recent coverage on climate change has been particularly gut-wrenching. Temperature records are being broken consistently and – in the case of February – to such significant extents that it's causing significant shock and alarm among climate scientists.

We have arrived at this situation, a full 19 years after the Kyoto protocol was agreed, since when the world's economy and associated emissions have expanded at an extraordinary rate, notwithstanding a global economic collapse. We have obfuscated, wrung hands, compromised and attempted to make only the most slight incremental progress, and as a consequence we may come to look back on these past two decades as the time when humanity failed to live up to its responsibilities. I look on these things differently as a new parent. Arguments that were largely academic to me before, now take on a visceral immediacy. The state of the world that my children grow up in matters to me, so when people talk about the need to develop sustainably for the sake of our children and their children, it has meaning for me. These are not children as anonymous concepts. They're heart-beating flesh and blood, looking into my eyes, trusting in me as someone who will protect and care for them. I cannot sit idly by and go through life knowing what our collective inaction is doing to their futures.

So we need radical, urgent, deep reductions in carbon emissions, and we need simultaneously to prepare to deal with the adversity that a warming world will throw our way. But in being radical, we must not be rash. We must roll-out solutions that not only promise to deliver and lock-in massive reductions into the long term, but that are backed by the most compelling, robust evidence possible. We can in no way afford to take a punt on this.

On a global scale this may amount to a drop in a rising ocean, but this is why I'm thrilled that an Irish local authority, Dún Laoghaire-Rathdown County Council, has shown genuinely world-leading resolve and ambition in passing a requirement into their new county development plan – in the face of not inconsiderable resistance – to make the passive house standard or demonstrably equivalent approaches mandatory for all new buildings in the county – not just new dwellings, but all new buildings. It's true that retrofit is a far greater challenge than new build, and that we must up our resolve to dramatically improve our sub-standard building stock, but with new build, there really is no excuse for doing anything other than best practice, especially given the surprising evidence that it need bring no capital cost premium.

No man is an island, as they say. Just like Britain, Ireland may be an island nation, but it is a vocal part of the European and international community, so when one part of the island commits to global best practice on thermal performance – as recognised by no less than the UN Intergovernmental Panel on Climate Change in their most recent assessment report – it has meaning, as the phenomenal viral response to this policy on social media has demonstrated. The UK's next door neighbour is becoming a world-leader on sustainable building, as bizarre as that sounds for an Irishman well versed in begrudgery to say. The question is – notwithstanding any restrictions in England specifically arising from an amendment to the Merton Rule – will any councils in the UK step up to the plate?

Regards,
The editor

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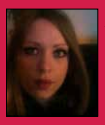

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Disclaimer: The opinions expressed in Passive House Plus are those of the authors and do not necessarily reflect the views of the publishers.

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News



Ecology's offices in Silsden, West Yorkshire

Ecology becomes first building society to be awarded Fair Tax Mark

Passive house & sustainable building mortgage provider Ecology Building Society has become the first building society in the UK to be awarded the Fair Tax Mark.

The Fair Tax Mark is the world's first independent accreditation scheme to address the issue of responsible tax, with Ecology being the latest company to be awarded the mark.

Ecology chief executive Paul Ellis said: "We believe that the fair payment of tax is an important part of our contribution to society and helps reduce inequalities which have an environmental cost.

"While tax remains a controversial area for many, as an ethical business with mutual values at our heart, we are proud to be the first building society to be awarded the Fair Tax Mark, which sets a benchmark for responsible tax behaviour.

"The Fair Tax Mark award is a further demonstration of our ethical approach. Our continued commitment to openness and honesty about our financial affairs sets us apart from most other financial services providers and plays a vital role in helping to deliver our mission to build a greener society."

The first Fair Tax Mark accreditation of a building society now opens up the opportunity for other building societies and ethical banks to demonstrate openness and transparency about their tax affairs.

Ecology Building Society was also recently awarded Living Wage Accreditation. Paul Ellis commented: "While all the society's salaries already exceed the Living Wage, accreditation demonstrates our commitment to maintain this, as well as ensuring that all contractors working on our premises will also be paid the Living Wage."

The society ensures all employees are paid at least £8.25 an hour, regarded as the real cost of living in the UK.

Ecology offers mortgage discounts of up to 1.25% on its standard variable rate – which is currently 4.9% - for sustainable buildings under its C-Change mortgage initiative, with the highest discounts awarded for homes that achieve passive house, Enerphit, Code level 6 or AECB Gold standard.

Innovative ventilation designs win passive house component award



The winners of the Passive House Component Award 2016, which focuses on ventilation solutions in the retrofit of residential buildings, have been announced. First prize has been awarded to a concept by the Austrian manufacturer Pichler, while a joint second prize goes to the Dutch company Vaventis and the Italian firm Michael Tribus Architecture. The presentation of the awards will take place at the 20th International Passive House Conference, which will be held on 22 and 23 April in Darmstadt, Germany.

The jury for the award assessed entrants for a compact duct network, low cost, flexible installation solutions, and life cycle cost. The winning solution by J. Pichler GmbH impressed the judges in how it was designed. According to the institute, putting the device at the centre of the building allows excellent access for maintenance work, while in addition, installation is facilitated by prefabricated component solutions, such as a combined unit consisting of a silencer, volume flow controller and distribution box.

Meanwhile, with a very narrow device and easy installation, Vaventis BV achieved a good rating particularly in the 'suitability for step-by-step retrofitting' category, and Tribus Architecture's design included a very compact duct network, as positioning the device near the exterior wall reduced external air and exhaust air ducts to a minimum.

"In order to supply the growing retrofitting market with high quality energy efficient ventilation systems, cost-effective solutions in particular are very much in demand," said Dr Wolfgang Feist, director of the Passive House Institute. "The winning concepts demonstrate in an exemplary fashion how this can work."

Details on the winners of the Component Award 2016 will be presented by Kristin Bräunlich, ventilation expert at the international Passive House Institute, at the conference in Darmstadt. Many of the manufacturers who participated in the competition with innovative solutions will also present their products in Darmstadt during the specialists' exhibition, which will take place on 22 and 23 April in parallel with the International Passive House Conference. A total of ten ventilation solutions were submitted for the award.

Photo: Passive House Institute

News

Market demand for sustainable homes massively underestimated - UK survey

The long-held claim that customer demand for purchasing sustainable homes is limited has been challenged in new research by UK leading housebuilder Redrow. On the contrary, 63% of the 1,730 prospective new homebuyers surveyed by Redrow indicated a desire to purchase a sustainable home and 38% actually said they intended to. In fact, 82% said they were willing to pay more for such a home, with more than a quarter prepared to pay at least a 6% premium.

As well as being questioned on their purchase intentions the research also delved into the factors that influence homebuyers' decisions. Those surveyed ranked lower energy bills as more important than a garden, parking space, amenities, external appeal/design of home, and fittings and appliances when choosing a home. Meanwhile 78% agreed the purchase of a 'greener' home was likely to have a positive environmental impact, and 92% had a positive attitudes towards making such a purchase. Interestingly, more than two thirds believed that 'significant others' in their lives would approve of the decision to opt for a greener home.

The data was analysed for an academic research project by Redrow Homes' sustainability manager Nicola Johansen, who said: "Our findings challenge the long-claimed, but previously under-researched, assertion within the industry that there is limited customer demand for sustainable homes. It also offers new insights into the factors that influence purchasers' decision making.

"As a responsible business, the drive to reduce the carbon footprint of our developments is high on our agenda. However, we also want to build the homes our customers want to live in and this research helps us to fully appreciate what purchasers are looking for from their home and their homebuilder."

With 60% of respondents agreeing or strongly agreeing that they would be more likely to buy a new home from a company constructing sustainable homes, the evidence suggests that building more environmentally friendly properties, and promoting their credentials, can add value for the wider construction business.





Cygnum's precision timber engineering at the Architype-designed UEA Enterprise Building, which was recently proposed by Treehugger.com managing editor Lloyd Alter as perhaps the greenest building in the world

Photo: Darren Carter

Tackle housing crisis with passive housing — Cygnum

Leading Irish timber frame manufacturer Cygnum has said that it is possible to tackle the housing crises in the UK and Ireland by mass-producing high quality timber passive houses on a large scale.

Following the move by Dún Laoghaire Rathdown County Council to make the passive house standard mandatory in the region, some critics argued that the new requirement would slow down the rate of construction.

Cork-based manufacturer Cygnum told Passive House Plus that new automated production equipment in its Macroom factory allows the company to produce up to 2,000 passive house units per year, or 35-40 units a week, allowing for the mass production of high quality, ultra-low energy housing.

"Cygnum welcomes Dún Laoghaire Rathdown's adoption of the passive house standard, and with Dublin City Council considering a similar requirement, we want to make it clear that it is very much possible to deliver passive buildings on a large scale quickly and efficiently," said Cygnum managing director John Desmond.

At this year's Ecobuild show in London, Cygnum launched its brand new Cygnum Passive brochure, which showcases the company's ability to deliver the passive house standard with its Cygnum Passive 350 timber frame system, which is certified to meet the standard by the Passive House Institute.

News

Alsecco announce partnership with Gale & Snowden Architects

Façade and external insulation specialist Alsecco, and passive house architects Gale & Snowden, have joined forces to provide "a complete passive house solution for the residential, commercial, refurbishment and new build sectors".

A statement from both companies read: "Passionate about eliminating fuel poverty and providing healthy and energy efficient buildings, both companies have the ethos and capabilities to offer clients cost-effective solutions built to the passive house standard."

With Alsecco's expertise in façade design through technically proven, high quality products and systems, and Gale & Snowden's approach to healthy building design, the companies said that, "clients can be assured of an optimal passive house solution that is in no way prohibitive in terms of design and creativity."

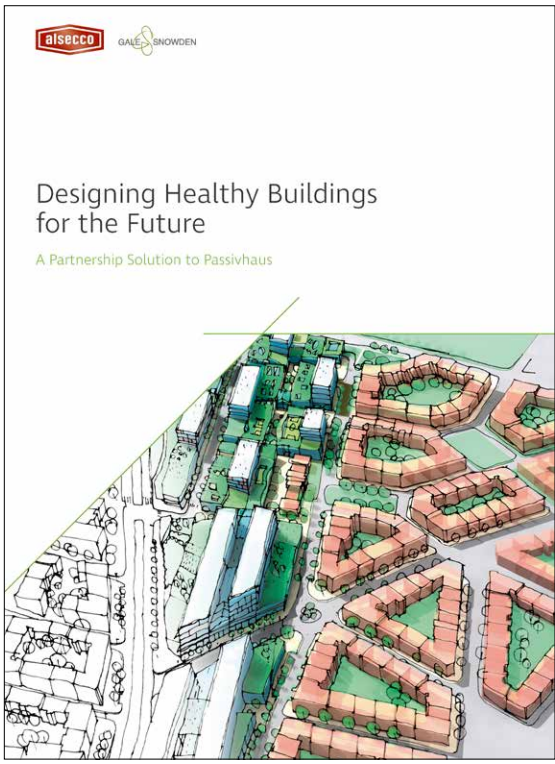
The key to the partnership is that clients will be supported throughout the project in an integrated and coordinated way, ensuring specific requirements are addressed and included, the companies said.

The partners are keen to dispel the myth that buildings built to the passive house standard have to look a certain way or be designed in a certain style. Their supply chain enables the sourcing of materials, products and systems to create the ideal solution for a client's passive house projects, and they are constantly looking for partner companies, especially those developing new and innovative passive house solutions.

Alsecco produce a wide range of products and service for architectural projects, including external wall insulation systems, rainscreen cladding systems, render-only systems, as well as façade and interior paints.

Gale & Snowden Architects is an award winning RIBA chartered architectural practice that focuses on regenerative design based on permaculture principles. The practice integrates ecology, building physics and landscape design with elegant and efficient architecture to create healthy, uplifting buildings and landscapes. Since 2008, the firm has been at the forefront of passive house design in the UK.

For a copy of their partnership brochure, Designing Healthy Buildings for the Future, email passivhaus@alsecco.co.uk



Pro Clima launch pre-folded plasterable airtight tape Tescon Profect





Ecological Building Systems are pleased to announce global leaders in innovative airtightness solutions Pro Clima have added a new range of pre-folded airtightness tapes, Tescon Profect to their array of intelligent airtightness solutions.

Ecological's senior engineer Niall Crosson said the new tape offers a number of unique advantages over similar tapes. "Tescon Profect is suitable for internal or external use, it is vapour diffusion open, airtight and it can also be plastered directly. It also offers high levels of flexibility.

Crosson added that complex junctions and longer installation times can significantly increase the cost of attaining the required levels of airtightness on projects, with corners often seen as one of the weakest junctions in the airtightness envelope. "A pre-folded corner sealing tape simplifies the installation of airtightness connections at intricate junctions such as windows, doors, roof lights and beam penetrations on the airtightness layer," said Crosson. "The majority of buildings in Ireland and the UK are still masonry constructions. The fact that Tescon Profect can be plastered directly and it is suitable for internal and external use offers the ideal airtightness solution for both timber frame and masonry buildings."

Tescon Profect tape is available with a 12-28mm, or 25-35mm split backing paper.

Ecological launches passive house envelope training

Passive house building envelope specialist training is now available at Ecological Building Systems, complementing the array of award-winning training courses Ecological have been delivering for almost 15 years now.

Darren O'Gorman, training and technical support with Ecological stated: "Following the success of the Pro Clima airtightness installer training and the Better Building, Putting the Fabric First courses, the addition of a certified passive house building envelope specialist course was the logical next step for us. The training facility at our headquarters in Athboy and the full scale practical models bring thermal bridging and airtightness details to life for the attendees".

O'Gorman said feedback from the first group of participants – which included both Irish and UK attendees – has been very positive. It is planned to run this course again later this year.

For more information regarding upcoming courses, Tescon Profect tape and the complete range of Pro Clima intelligent airtightness solutions visit www.ecologicalbuildingsystems.com

(Top left) Tescon Profect, a pre-folded, plasterable airtight tape. (Bottom left) Ecological Building Systems trainer Darren O'Gorman delivering the company's first passive house building envelope specialist training course in Athboy, Co Meath

News

Irish council makes passive house mandatory in historic vote

All new buildings in south-east Dublin must be built to the passive house standard or demonstrably equivalent levels, in a move that may lead to the construction of upwards of 20,000 homes and unprecedented volumes of non-residential buildings to the passive house standard by 2022.

One of four local authorities in the Dublin region, Dún Laoghaire-Rathdown County Council adopted its county development plan for 2016-2022 on Wednesday 17 February, including a motion worded by Passive House Plus editor Jeff Colley that all new buildings must be built to the passive house standard or equivalent. Colley and fellow colleagues in the Passive House Association of Ireland – which has presented Colley with a special recognition award for this work – had been campaigning for this policy since the start of 2015.

The motion, which was sponsored by Fine Gael councillor Marie Baker, passed by a majority of 27-10, winning support from members of every political party, including nine out of eleven Fine Gael councillors, four out of seven Fianna Fáil councillors, all Green Party, Sinn Féin and People Before Profit councillors, and five out of six independents. Just one of the council's seven Labour councillors voted for the policy, leaving Labour as the only party where a majority of councillors didn't back the policy.

The Passive House Association of Ireland commissioned a legal opinion from planning, European and competition law experts Philip Lee Solicitors, to address concerns raised by the Department of the Environment about the legal basis for the passive house policy.

The wording of the agreed motion is as follows:

All new buildings will be required to meet the passive house standard or equivalent, where reasonably practicable.

By equivalent we mean approaches supported by robust evidence (such as monitoring studies) to demonstrate their efficacy, with particular regard to indoor air quality, energy performance, comfort, and the prevention of surface/interstitial condensation. Buildings specifically exempted from BER ratings as set out in S.I. No. 666 of 2006 are also exempted from the requirements of Policy CC7.

These requirements are in addition to the statutory requirement to comply fully with Parts A-M of Building Regulations.

Dún Laoghaire-Rathdown published the final text of the adopted county development plan on 16 March, although the new development plan came in with immediate effect on 17 February, meaning all planning applications in the county from that point on must pass the passive house or equivalent test.



(Above) Passive House Plus editor Jeff Colley accepting the PHAI's special recognition award for his campaigning work on the Dún Laoghaire-Rathdown passive house policy.

DVS install passive roof lights at University of Leicester's Centre for Medicine





Leading passive house rooflight supplier DVS recently designed, supplied and installed two large Passive House Institute-certified glass roofs for the University of Leicester's Centre for Medicine, the largest non-residential building built to the passive house standard in the UK.

Each measuring 6.5m by 15.6m, the two glass roofs utilise the well proven Lamilux PR60energysave system, installed with a surface inclination of just 3 degrees.

This project is among many passive-certified rooflights installed by DVS, the first UK rooflighting business to specialise in passive house projects.

As the world's first passive house certified glazed roof system, the PR60energysave sets the benchmark for energy efficiency standards for atrium glazing. It has been independently assessed by the Passive House Institute and awarded the highest efficiency rating, the phA Advanced Component classification.

The system features a Ucwi value for the complete skylight of less than 0.82 W/m2K, utilising warm edge triple layer glazing with SuperSpacer as standard.

The aluminium extruded mullion/transom glazing bar system allows for designs of any shape, inclination and size, and can be supplied in any RAL colour.

At the University of Leicester's Centre for Medicine, two atria feature glazed vertical sections with six opening vents in addition to the glass roofs, bringing high levels of daylight and natural ventilation to public areas within the building.

The centre provides a new home for the university's medical education, health sciences and psychology departments, with approximately 12,000 square metres of teaching rooms, academic offices, dry lab research facilities and support spaces capable of accommodating more than 2350 staff and students.

(Left) The University of Leicester's Centre for Medicine features the Passive House Institute-certified Lamilux PR60energysave rooflighting system.

News

Autarco launches made-in-Europe microinverter



(Above) Autarco's new XSX microinverter

PV specialist Autarco has developed a microinverter which, it says, outperforms traditional inverters in terms of yield per module, flexibility, safety and reliability. It combines "ultra-reliable components with a distributed architecture that makes for a more resilient power plant", according to Autarco sales director Lloyd Lawson.

Lawson said that as the solar industry matures, it's moving away from large scale open plants and towards local roof-based power plants. Today, even building integrated (BIPV) systems are starting to be competitive alternatives in some scenarios. But from an inverter perspective the built-up environment poses challenges, like complex shadows and orientations.

"The Autarco microinverter is not limited by the lowest performing module in a string and therefore has a higher yield per module, up to 3.1% more than leading DC-optimized string inverters," said Lawson. "It is proven to produce more at dawn, dusk and in low light conditions. The total cost of ownership is lower and return on investment is better with microinverters than string inverters when considered over the lifetime of a PV installation. Microinverters are shadow tolerant and allow for easily scalable systems that provide ultimate reliability with a design life of over 25 years."

Lawson said that all other microinverters have a so-called 'potted design'. This means that the internal chamber of the enclosure is filled with an encapsulating compound which effectively makes the entire product a solid block.

"The Autarco XSX microinverter is designed with the crade-to-cradle philosophy in mind," said Lawson. Its PCB is coated with a layer of transparent conformal coating rather than potting. This more modern technique is lighter and easier to inspect, test, and repair. It also allows all durable materials to be 100% recyclable."

Lawson add that the Autarco XSX300 microinverter is the world's first solar inverter with built-in wireless Z-Wave functionality. "Z-Wave is far more reliable than WiFi and it is the leading protocol for wireless machine-to-machine communication and internet-of-things applications," he said. "It easily integrates in the Autarco Smart Home platform, which allows users to not only generate their own energy, but also take the next step towards a more energy efficient home or business by maximising self-consumption."

Autarco said that it is the first brand that integrates individual components in complete single-branded solar energy systems. All systems come with a kWh guarantee. The company is based in Shanghai and Eindhoven and has worldwide sales.

Smet launches new screed ideal for low energy houses

Smet have announced the launch of a new floor screed that can be installed in significantly reduced thicknesses, allowing for the use of extra floor insulation. The screed is also designed to complement underfloor heating systems, and to respond quickly to changes in room temperature. Sopro Rapidur FE 678 is a rapid-set, self-levelling screed, walkable within three hours and ready for tiling in 24 hours. The dry screed can be finished with the usual plethora of floor coverings but, uniquely, this screed allows the contractor the option to leave in its natural state and grind and polish it to a contemporary finish. This creates a compact, visually appealing 'terrazzo-style' floor finish. The polishing process smooths the surface, revealing the inherent aggregate. This organic look is of great appeal to most clients who want the polished effect.

Joris Smet, director of Smet Building Products Ltd, said: "It's not often we see a game-changer in this long-established industry. However, our German manufacturing partner, Sopro have really done it this time. The unique properties of this pumpable, rapid-set screed really sets it apart. Particularly useful for thin underfloor heating systems, fast-track and tightly scheduled screed laying, the product offers the option of final polishing to a contemporary, visually appealing terrazzo-style surface."

Rapidur FE 678 has minimum shrinkage and therefore does not curl, it fully encapsulates the underfloor heating pipes, has a high thermal conductivity and can be installed in significantly reduced thicknesses. This allows thicker insulation to be used under the screed, resulting in better thermal insulating values or U-values. This means the screed gains heat rapidly and transports heat to the surface of the screed and into the air, resulting in an efficient response in room temperature changes.

Smet said thin floating self-levelling screed is more energy efficient, responding quickly to changes in room temperatures. "Traditional thick screeds cannot respond as efficiently to, for example, solar gain in the afternoon or when a fireplace is lit in the winter," said Smet, adding that this ineffective response (heating/cooling) often leads to a room being too hot or too cold, a problem eliminated by application of Rapidur FE 678.

Rapidur FE 678 self-levelling screed is a polymer-modified, ready-to-use dry mix for production of rapid-set screeds allowing early flooring installation. It's suitable for heated screeds, bonded screeds and unbonded screeds (on a separating or insulation layer). It can be used as a base for all types of floor covering, and it's particularly suitable for a wide range of thin-coat heating systems.

(Below) Sopro Rapidor FE 678, an innovative floor screed that lends itself towards a polished finish, available in Ireland and the UK via Smet





News

Trunk Low Energy Building launch new CLT business

Trunk Low Energy Building has announced a brand new venture, Trunk CLT, which provides a specialist structural engineering, fabrication and erection service for any client or architect who desires an inherently low energy cross laminated timber shell solution for their project.

Trunk director Mike Jacob said that CLT is a very efficient structural and aesthetic solution, ideal for low energy projects where high levels of airtightness are required. The Trunk CLT system has an integral airtightness layer within the panels. “In most cases there is no need for extensive use of tapes and membranes,” said Jacob.

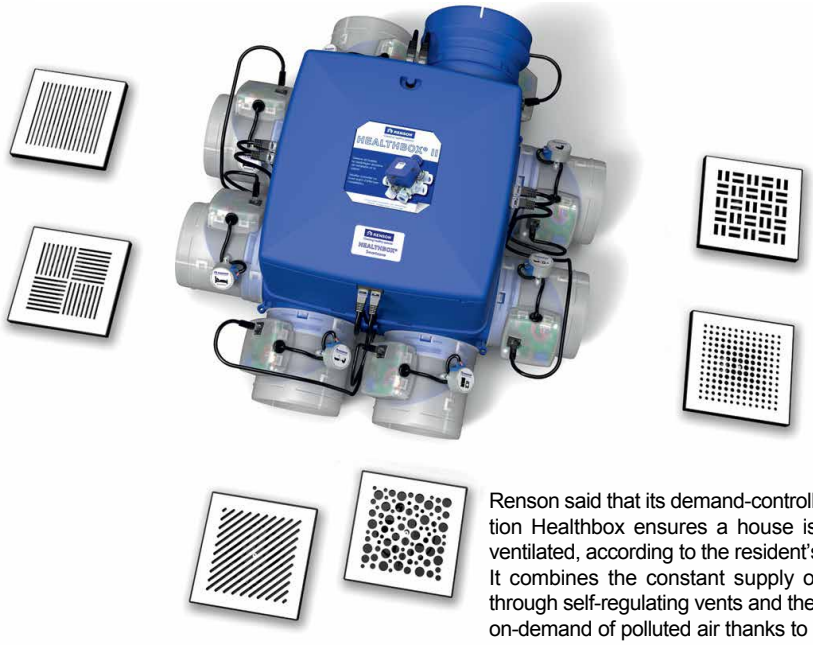
The large format panels are made to order to eliminate wastage. They come in sizes of up to 3.5m by 20m. CLT enables clients and main contractors to achieve rapid erection and simplicity for follow on trades, providing significant programme advantages.

“I was seduced by CLT about 10 years ago and have been waiting ever since to get involved in this sexy end of the market,” said Jacob. “The timing is perfect to bring together the right people, with the right manufacturing partners to focus on smaller, one-off projects. The existing, established players can take care of the big stuff – at Trunk CLT we are interested in the more interesting and unique work, typically for domestic clients. At Trunk Low Energy Building we have seven years of work under our belts for exactly this audience and we understand their needs very well.”

Trunk CLT will be on site with their first project in Hertfordshire this summer and are in the early design stages of several more. For more information visit www.trunkclt.com



Renson Healthbox DCV unit nominated for two awards



The Renson Healthbox has been announced as a finalist in two categories for the 2016 H&V News Award in two categories.

The product has been shortlisted in the ‘air movement product of the year’ and the ‘domestic H&V product of the year’ categories. The Renson Healthbox is an intelligent demand-controlled ventilation (DCV) unit. The awards take place on 21 April in the Grosvenor Hotel in London.

Renson said that its demand-controlled ventilation Healthbox ensures a house is optimally ventilated, according to the resident’s activities. It combines the constant supply of fresh air through self-regulating vents and the extraction on-demand of polluted air thanks to the central extraction Healthbox unit. Dynamic sensors measure the extraction air 24 hours a day for CO2, relative humidity and/or VOCs, and adapt the ventilation level to the needs of the residents in an intelligent way.

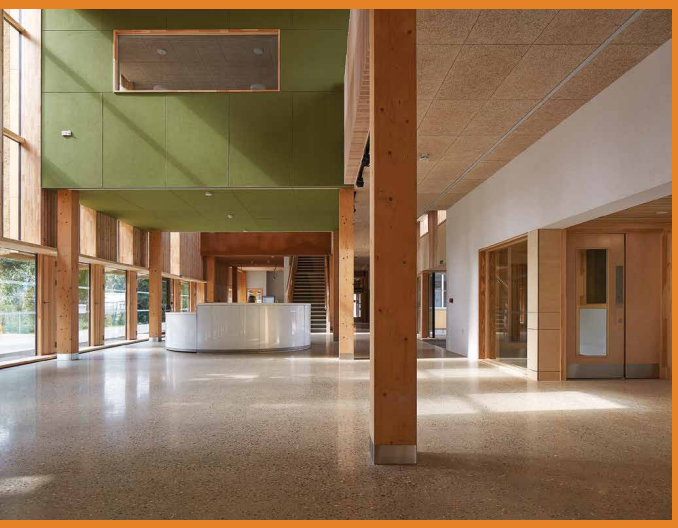
The Healthbox is installed in an unused corner in the attic or in a technical room. In the kitchen, bathroom, toilet or any other room where the polluted air is extracted, the user only sees an aluminium vent. The fan is calibrated automatically and regulates itself so as to achieve the exact extraction capacity for each room. This avoids the risk of adjustment errors, thereby ensuring a properly working ventilation system with a proper flow rate in each room. This automatic calibration also leads to significant time savings, as installation takes only a couple of minutes.

Renson is a specialist in ventilation, solar shading and terrace covers. From its UK-based production facility in Maidstone, the company provides standard as well as customised solutions to the construction market and offers architects, specifiers, developers, fabricators and installers a wide range of innovative systems. Its product ranges includes window ventilators, louvres and continuous louvre systems as well as hinges, sun protection elements with aluminium blades and screens and terrace covers.

For various applications in the UK, the project team of Renson has been developing special ventilation solutions with louvre panels, combined with options, such as dampers or an insulation stack on the backside. Renson said that by integrating such special glazed-in louvre panels with insulation on every window of a building, architects and installers not only take care of ventilation and thermal resistance, but also add a new architectural dimension to the façade of the building.

(Above left) Renson’s Healthbox DCMEV system, which comes with six different extract vent designs







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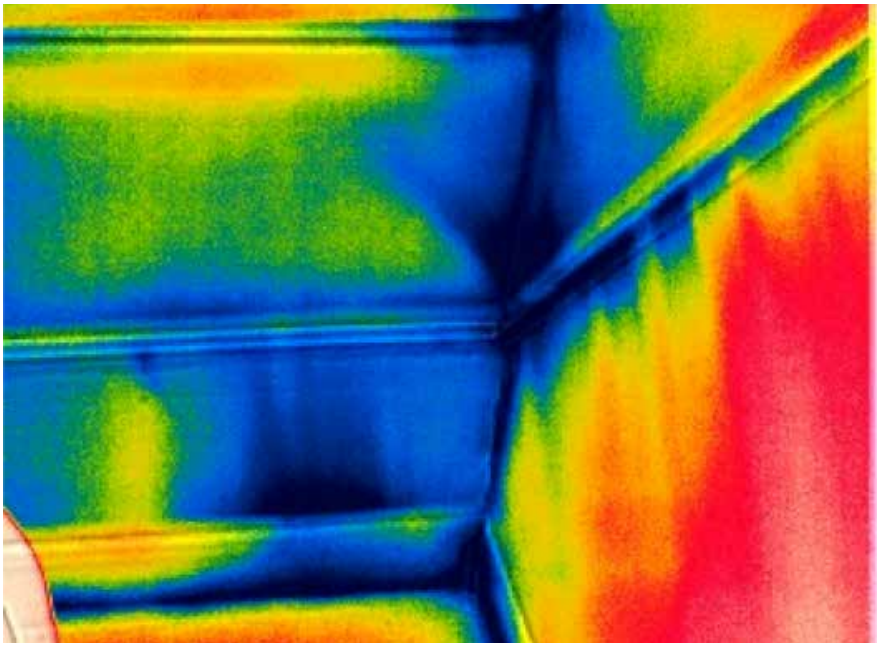
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News

AECB local groups: report on recent events

The Association for Environment Conscious Building (AECB) has a network of local groups that organise events and provide an opportunity to meet with other members. Here's a taste of what they've been up to recently.





(Above and left) Thermal image of dormer section of a building whilst airtightness testing; (below, from left) Stephen Gurney from Ecological Building Systems talking at the Kent Group presentation; Gloesgerddyn house, which was visited with the retrofit and extension nearly complete; Alan Budden from Eco Design Consultants speaking on the AECB silver standard for large scale projects

Cornwall/Devon Group attend airtightness & thermal imaging demo

Rachel Simpkins of South West Air Energy (SWAE) donated her time to give an extremely useful, practical demonstration on thermal imaging and simultaneous air leakage testing of a building. AECB members had a rare opportunity to see these practical tools used on a new build test property, and discussed ways to minimise air leakage and apply good practice methods on site for different construction methods.



Kent Group attend presentations on insulation, airtightness and ventilation

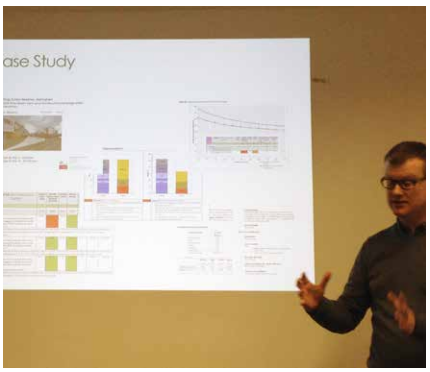
Cellulose insulation has long been a favourite in the green building arena and it was interesting for members and guests to hear from Warmcel and Cuir about how it is made and installed, its properties in both winter and summer conditions, and performance under fire tests. MVHR is a key component in low energy buildings but its efficiency is dependent on good design, installation and the right choice of ductwork and diffusers, attendees heard from Systemair, whose units are now tested to the new Eurovent certification scheme. But neither insulation nor ventilation systems will work properly in a leaky building so Ecological Building Systems discussed their wide range of Pro Clima membranes and tapes for interior and exterior use, as well as their new range of external waterproof tapes.



Wales group visit retrofitted house and extension

Built during the 19th century, Gloesgerddyn consisted of a solid grey stone house with a slate roof, onto which a rendered block-work extension had been added in the 1990s.

The design brief was to convert, retrofit and extend the gatehouse to provide a comfortable home. The solution was to add a generous two-storey extension, timber-framed with a rendered block-work external skin, slated roof and good levels of insulation. The walls and roof of the original house have also been retrofitted with internal insulated dry linings. The new and existing floor slabs in both areas have also been well insulated. New, high quality double-glazed windows and doors have been fitted and the lean-to boiler room on the back of the extension contains all the main heating equipment, plumbing and controls, including a Windhager biomass boiler, fed with wood pellets by air pressure from a storage hopper below. The extended house is now heated by a combination of underfloor pipes, radiators and a central wood-burning stove.



Milton Keynes group discuss large scale AECB Silver

Architect Alan Budden spoke on the AECB silver standard for large scale projects, talking practically on a recently completed 63-unit scheme at Green Street Nottingham. Discussion focused around how to improve implementation and the need for improved knowledge on site around airtightness strategies. There was general agreement that this is a great standard for improving the comfort, performance and standard of new homes. But there was a concern that an airtightness of 1.5 might be too challenging for large scale developers, therefore putting them off adopting the standard.

For more information about the AECB visit http://www.aecb.net



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News

Potton passive show house achieves 0.5 ACH with Wraptite membrane





The UK's first permanent passive house show house has been built by Potton using the Kingspan Tek building system, and joins four existing show homes at Potton's self-build show centre in St Neots, Cambridgeshire. The house uses a Wraptite-SA (self-adhered) air barrier membrane, supplied by the A. Proctor Group.

Wraptite-SA is both vapour permeable and airtight, combining two important properties in one BBA certified solution for wall and roof applications. Its "unique" vapour permeability allows the air barrier to be positioned externally, leading to a faster and more robust installation, with fewer penetrations for building services and structural elements, according to Proctor.

The membrane is designed to significantly improve the building's thermal performance by preventing lateral air movement, while ensuring a healthy building and living environment due to its high degree of vapour permeability. The project managed to achieve an airtightness score of 0.5 air changes per hour at 50 pascals, exceeding the passive house standard of 0.6.

The show house was designed by HTA Design, and Potton worked closely with the HTA team and passive house design experts WARM, to ensure the house met the passive house standard.

'We wanted to show customers first hand that passive house buildings are wonderful places to live in, and we wanted to dispel myths that the passive house design has to be boring and boxy,' said Potton's technical director Paul Newman.

The Potton show centre based in Little Paxton, St Neots welcomes over 5,000 visitors per year and attracts aspiring self-builders from around the country.

You can explore the passive show house at various stages of its build by visiting www.selfbuildlive.com. For further information on the Wraptite-SA membrane, visit www.proctorgroup.com

(Above) The A. Proctor Group's Wraptite-SA membrane, an externally applied airtight layer applied here to the Potton passive show house, which achieved 0.5 air changes per hour at 50 pascals, exceeding the passive house target of 0.6

The Keystone Group launches online Psi-value calculator



The Keystone Group is the first lintel manufacturer to offer an online Psi-value calculator designed for energy assessors and architects.

The company said that with the calculator, users can obtain a Psi-value with just a few clicks of a button, completely free of charge.

Generally this information takes a specialist company a few days to turn around, with typical costs between £200 and £400 per detail, according to Keystone.

By using the calculator, energy assessors can now directly input the lintel Psi-value into their Sap calculations and view the performance benefit. Specifically calculated Psi-values will help to lower the thermal bridging y-value within the Sap calculation, assisting with Part L compliance.

To ensure accuracy, all Psi-value calculations have been generated by trained thermal modellers using Physibel Trisco software.

Keystone is urging anyone with additional queries or problems with working out Psi-values to contact the Keystone technical services team. For more information see www.keystonelintels.com

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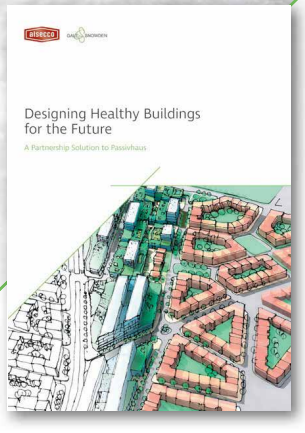
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Where has the national retrofit programme gone?

Ever since David Cameron's alleged utterance in 2013 of the need to "get rid of all the green crap" from energy bills, government policy on the green economy has nosedived. The nascent retrofit sector has been badly damaged, writes Peter Rickaby, but all is not yet lost.

In October 2008 the UK Green Building Council, supported by the Energy Efficiency Partnership for Homes, the Existing Homes Alliance, the Sustainable Development Commission and the Technology Strategy Board, produced a report entitled Low Carbon Existing Homes. The purpose was to provide a 'roadmap' to reducing the emissions associated with domestic energy use by 80% by 2050. Much of that report is still relevant; amongst the conclusions were:

A clear statement of vision from government, coupled with targets for the household sector and a long-term delivery strategy are… essential requirements for the investment and scaling up required… to deliver low carbon homes. Industry needs as much long term certainty as possible so policy targets and funding schemes need to be clear, consistent and stable.

The report was well received by the Labour government, and there followed a flurry of workshops that culminated in the Warm Homes Greener Homes strategy, a suggested energy standard for social housing, development of the Feed-in Tariff and Renewable Heat Incentive, and funding for CERT and CESP. A national retrofit programme began to look like a real possibility. It was established that we must improve at least twenty million homes, at an average cost of £25,000, and an overall cost of £500 billion. Between 2010 and 2050 the average improvement rate would need to be one home per minute, but we believed that it could be done.

Then the 2010 general election intervened. It soon became clear that the coalition government's green initiatives originated with the Liberal Democrats and had only reluctant support from the Conservatives. The Feed-In Tariff was cut and the Renewable Heat Incentive stumbled. The Green Deal finance scheme was dragged into existence by a naïve minister and a team of civil servants who consulted eagerly with big business (potential Green Deal providers) but never listened to people with retrofit experience. The Green Deal failed – it was too complicated, too expensive, did not work for social housing and lacked any promotion or incentives for householders to improve. The failure confirmed to the Conservatives that energy efficiency is politically toxic – the supply side is safer territory.

However, the Green Deal Home Improvement Fund (GDHIF), which offered subsidy rather than loans, was quickly over-subscribed, demonstrating significant repressed demand. Householders do want to improve their properties, especially as they see fuel prices rising, but they are unable to pay for the work themselves.

In parallel the minimum energy standards for private landlords and the fuel poverty standards for social housing focused attention on the need for improvement, but in the absence of a coherent policy from government or the Homes and Communities Agency, social landlords began to chase Energy Company Obligation (ECO) money instead of integrating retrofit into their strategies. Meanwhile ECO, based on carbon saving targets, presided over a race to the bottom in both the cost and quality of improvement, resulting in disastrous attempts to deliver measures such as external wall insulation at half the realistic cost.

In the summer of 2015, following another general election and with the Conservatives in control, it seemed that the foundations of the national retrofit programme were being dismantled. The zero carbon standard for new homes (which was supposed to relieve the carbon burden) was abandoned; renewable energy subsidies were slashed to non-viable levels; the Green Deal and GDHIF were closed; the heat metering regulations were suspended; the first phase of ECO was extended to 2017, effectively reducing its scope, and the second phase has been re-focused on fuel poverty. Consequently, organisations promoting or delivering retrofit, or providing skills and training, have gone out of business; many others are struggling. The 'policy pause' now awaits the Bonfield Review, but one leading retrofit consultant remarked recently that if the government waits much longer to announce a new policy there won't be an industry left to deliver it.

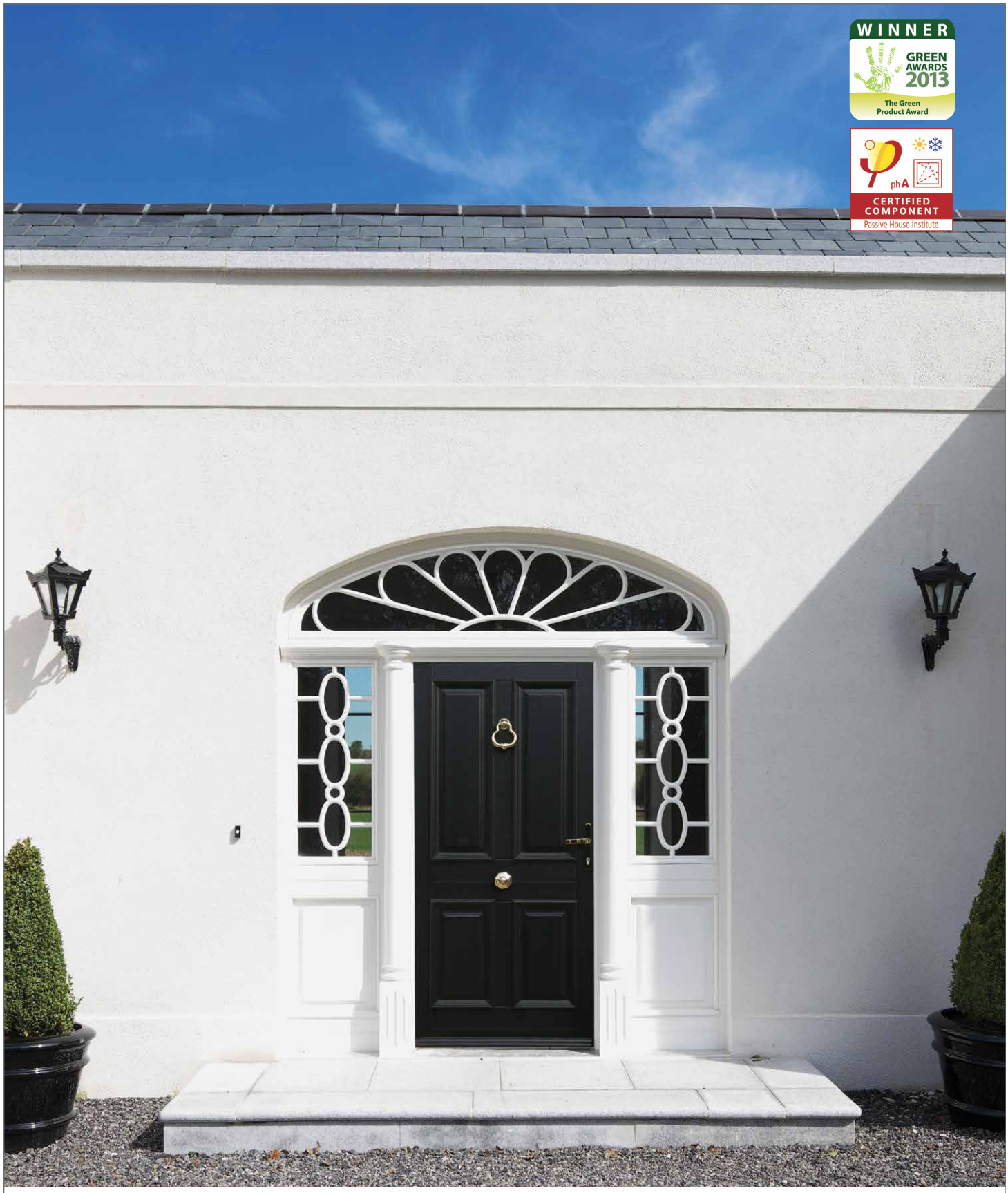
Is there some light amongst this gloom? Yes, industry has risen to the challenge of the Bonfield Review by contributing real leadership. Some robust ideas are emerging for retrofit standards and guidance, for assessment, design and installation processes, for quality assurance and for the engagement of households. The industry can build a robust retrofit process, but the challenge will be for government to deliver a policy that promotes retrofit, and provides householders with incentives.

There has also been progress in other areas. One-off retrofit experience gained from the TSB/IUK Retrofit for the Future competition has been translated into the acclaimed CoRE retrofit coordinator training that is now being revived by The Retrofit Academy. Retrofit for the Future, combined with research by BRE, the STBA and others, has taught us where retrofit goes wrong, how to manage the movement of moisture through building fabric and how to manage retrofit risks. The TSB/IUK Scaling Up Retrofit competition, and initiatives like Energiesprong have taught us about the processes that are needed to deliver retrofit at scale.

The national retrofit programme has not gone away. It has been temporarily hidden by politicians who lack the courage to explain what we need to do and to provide leadership. Climate change remains a threat, and a national retrofit programme is an essential component of our response. We are much better placed to deliver that programme than we were in 2008, so the immediate challenge is to get behind the Bonfield Review and once it is published demand a policy that will promote retrofit so that we can deliver it.

Peter Rickaby is director of Rickaby Thompson Associates Ltd, a member of the Board of Trustees of the National Energy Foundation, and a former director of CoRE. The views expressed in this column are his own.

"We must improve at least twenty million homes, at an average cost of £25,000, and an overall cost of £500 billion. Between 2010 and 2050 the average improvement rate would need to be one home per minute."



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Zero energy, zero sense?

The EU says that each new dwelling should be 'nearly zero energy' from 2021. But it doesn't seem to fully understand the restrictions of electricity networks. There are better ways to meet the underlying spirit of the EU directive, argues David Olivier.

There is an apparent 'explosion' of passive house-related energy standards: both the passive house and Enerphit standard respectively come in classic, plus and premium versions.

The "plus" classes are related to the EU's decision to mandate nearly zero energy building standards – which are almost net zero energy – on all new public buildings by 2019, and all new buildings by 2021.

On so-called 'nearly zero energy' residential buildings, I predict that electricity will typically be generated from a rooftop solar photovoltaic array. The dwelling will be connected to the national grid. It will export and import electricity as needed.

The EU directive, as it has been interpreted by member states, excludes plug-in lights, white goods and other equipment. It focusses on space and water heating and cooling, and built-in equipment – pumps, fans and wall or ceiling lights. To achieve 'annual energy balance' with these 'regulated energy uses' could mean fitting a 2.5 to 3 kilowatt PV system to a typical dwelling.

The EU has often produced good environmental legislation. But has this directive introduced too many contradictions and inconsistencies?

Flaws?

The directive seems to fail to address several points:

a) limited electricity network capacity;
b) the lack of economical electricity storage methods;
c) the six month time difference between peak solar electricity supply and peak space heating demand.

Network capacity

The peak electricity consumption of a group of houses with electric space and water heating systems, such as air source heat pumps, will need a larger substation and fatter cables than normal capacity. Six months out of phase with this new winter peak demand, there is a new summer peak supply from a PV system on every dwelling. If it exceeds 0.75-1.0 kW, the peak supply may overload the network. The choices seem to be either to increase the substation capacity or limit the peak load on it to 0.75-1.0 kW/dwelling.

If we go for the second, more affordable alternative, this seems to demand that a) heating is not electric and b) residential PV systems are limited in capacity.

Energy storage

'Store it!' is another stock response to the potential problem of too much summer PV electricity. But in a house, how?

'Dump' it as hot water? A 150 litre domestic hot water tank cannot hold enough. Small dwellings have little room for more storage.

Store it in batteries to run lights and appliances on cloudy days or at night? Normally, batteries are located in a shed or garage. Not all new dwellings have one. Inexpensive, compact battery banks that can store several summer days' worth of surplus electricity are still being developed.

Produce your own energy?

It is misleading to say that dwellings with rooftop PV produce all, or even 'nearly all', of their energy. They might be regarded as 'net zero energy' over a year. But they're not 'zero fossil fuel' or 'zero carbon' as many believe.

On a freezing, dull winter day, rooftop PV and wind farms produce minimal amounts of electricity. Flexible gas or oil-fired generating plant would be fired up to meet the inevitable electricity deficit.

Dwellings with PV on the roof produce solar electricity in the summer, reducing the load on fossil-fuelled power stations, but consume gas or coal-fired electricity in winter. This goes to operate their electric heat pump, if the building is heated that way. I think that the EU directive risks continuing the misunderstanding which surrounds this subject.

Falling electricity consumption

As Andrew Warren notes, UK domestic electricity consumption for lights and appliances has been slowly falling. Few people are aware of this.

If a new dwelling's heating is non-electric, its daily average electricity consumption might be 0.25 kW in December to run a houseload of energy-efficient appliances and lights, falling as low as 0.15 kW in summer. Long term, it may go lower still.

This declining consumption by lights, appliances, fans and pumps gives even less case for increasing network capacity to new houses beyond the customary 0.75-1.0 kW. If it is unnecessary to fit larger cables just to safeguard their supply of 'essential electricity', why increase it for rooftop PV?

Network stability

In the 20th century, 'keeping the lights on' summed up the challenge to the operators of the national grid. Failure to do this, after all, brought down the Heath government in February 1974.

Fast forward to today though and imagine no shop tills, mobile telephones, internet, desktop PCs, etc. for 6-12 hours. It would be more than inconvenient. Proposals that risk destabilising this flow of 'essential electricity', by adding new peaks in demand or supply, should be treated with caution.

Long term

In say 2050, a UK operating mostly on renewable energy might need the equivalent of far more than 2.5 kW of PV capacity per dwelling. But is it most sensibly located on dwellings? Perhaps not. My inclination would be to fit new residential development post-2020 with 0.75-1.0 kW of PV per dwelling; confine the rest to larger installations where it can be professionally managed, and maybe connect large 'solar farms' to the 11 kV, not the 415 V electricity network. For security of supply, I'd convert unwanted electricity surpluses to forms of energy that utilities can store long term, in bulk, at moderate cost, such as fuel and hot water. I'd avoid electric heating, including heat pumps, unless and until the network security and financial implications are thought through.

The annual energy output of the UK's PV panels would be the same. Fewer of them would be located on new house roofs. The revised arrangement would still meet the spirit of the EU directive but could be cheaper and more practicable.

The concepts of 'net zero energy' and 'positive energy' buildings could disappear without trace. They have outlived their usefulness.

David Olivier is principal of Energy Advisory Associates.

www.energyadvisoryassociates.co.uk

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INTERNATIONAL SELECTION

The Living Building Challenge is arguably the world's toughest environmental building certification program. In order to achieve the award, buildings must meet rigorous standards in seven different performance categories, also known as 'petals': place, water, energy, health and happiness, materials, equity and beauty. To date only eight buildings have been fully certified to the standard worldwide, but many other buildings have achieved 'petal certification', meaning they meet the goals of three or more categories, and 'net zero energy certification', which recognises buildings that meet the challenge's energy criteria. Here are a selection of three American buildings that have been certified to one of these standards.



Photos: Jeremy Bittermann/Terry Lorant



Packard Foundation Headquarters, Los Altos, California

The David and Lucile Packard Foundation in Los Altos, California is a philanthropic group dedicated to solving the world's most intractable problems. The foundation's new headquarters employs passive, bioclimatic design strategies that support this core philanthropic mission, achieving both LEED Platinum and Living Building Challenge net zero energy certification. It is also the largest net zero energy office building in California, and aims to demonstrate how an organisation can improve its effectiveness and the quality of life for its employees while drastically cutting carbon emissions.

The building was constructed from a wood and steel hybrid structure, employing FSC certified timber, and low carbon concrete for the foundations. It also features a 291 kW solar PV system. Individual branch circuit monitoring is employed so that the energy consumption of each load can be pinpointed and pieces of equipment which consume large amounts of power can be easily identified. The building design, consisting of two long, narrow wings surrounding a centre courtyard, reduces energy consumption by maximising daylighting. Light shelves project natural light farther into space and reflect it off the ceiling, diffusing daylight throughout the space.

Naturally, the design team paid careful attention to material selection too: wood veneer was sourced from eucalyptus trees felled at a construction project in San Francisco, exterior wood is FSC-certified western red cedar, while stone is from Mt Moriah on the border of Utah and Nevada, all within a 500-mile radius from the site. The exterior copper is 75% recycled, with a long life span and integral finish. And the building apparently uses a total of 74 kWh/m^2/yr in energy, but produces even more than that through solar power, ensuring it achieved net zero energy certification. ▶





Photos: Paul G Wiegman/dllu



Phipps Centre for Sustainable Landscapes, Pittsburgh

Phipps Conservatory and Botanical Garden's mission is to inspire and educate people about the beauty and importance of plants, advance human and environmental wellbeing, and to celebrate its historic glass houses. All three goals are evident at the Centre for Sustainable Landscapes (CSL) in Pittsburgh, which is a fully certified Living Building, and provides office, classroom, research and library space for the group.

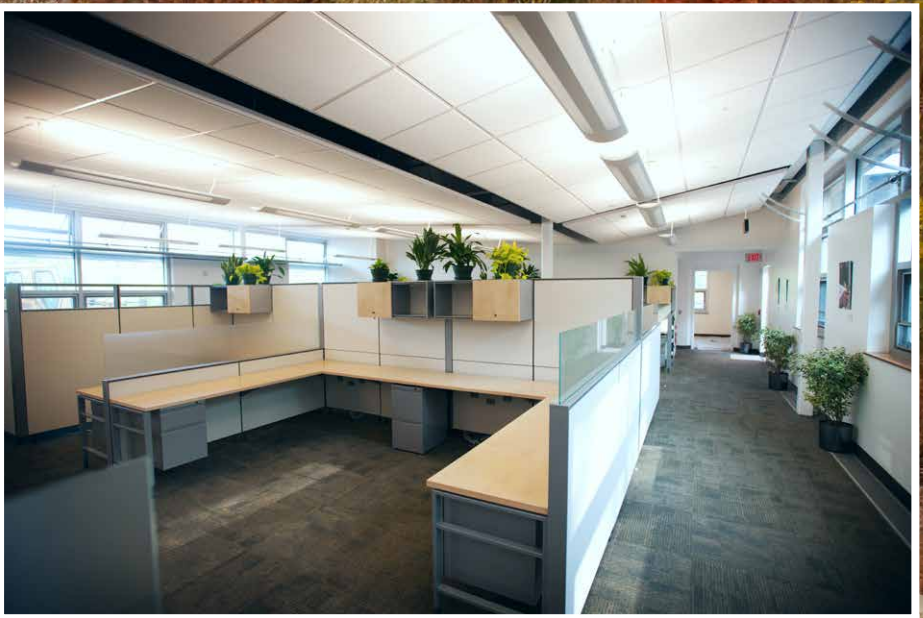
The building is of concrete and steel construction with a wood façade and metal frame windows. It consumes 57 kWh/m^2/yr of energy, but produces slightly more from its 125 kW solar photovoltaic array.

A green roof has also been installed to reduce the heat island effect. Mechanically, the building is primarily served by an underfloor air distribution system that introduces fresh air into the building. When outside air conditions permit, the building is cooled by natural ventilation through motorised operable windows.

Meanwhile, geothermal wells feed water cooled compressors for both heating and cooling loads, providing preheated water to the air handling unit in the winter and cool water during the summer. Rainwater is captured from not only the CSL site but the substantial rooftop space of the adjacent Tropical Forest Conservatory.

The facility is located on the Phipps campus' southwest corner, nestled into the hillside on a remediated brownfield lot once used as Pittsburgh's Department of Public Works storage facility and service yard. The site had been paved over several times and suffered decades of environmental devastation. Indigenous, sustainable plants and soil were brought in to rebuild the hillside nearly from scratch. Today, a terraced garden leads downhill from the roof to the ground floor of the centre, allowing visitors to walk a trail of native plant communities, including wetlands, oak woodlands and upland groves. ▶

Work is due to begin on the UK & Ireland's first Living Building, dubbed LH1, in the hills of south Dublin later this spring. The house is designed by Solearth Architecture, whose director and partner Brian O'Brien is the UK & Ireland's only professional accredited by the International Living Future Institute, which administers the LBC.





Bullitt Centre, Seattle, Washington

Backed by its mission to protect the Pacific Northwest's natural environment and promote healthy and sustainable ecosystems, the non-profit Bullitt Foundation wanted its new headquarters to achieve the highest level of sustainability. The foundation also wanted the building to be a demonstration project that would set a new standard for developers, architects, engineers and contractors, so decided to aim for the Living Building Challenge, and the building achieved full certification to the standard.

The new centre is a six-storey commercial office building, powered by a 244 kW rooftop solar array composed of 575 PV panels. All rainwater that falls on the site is collected in a cistern in the basement, treated to potable drinking standards,which supplies all the water needs of the building. Meanwhile the centre's six-storey composting toilet system creates a usable fertiliser at the end of its process.

The building is a type-IV heavy timber structure, made of Forest Stewardship Council (FSC) certified glulam beams and dimensional lumber, and insulated with formaldehyde-free fibreglass that employs a plant-based binder material. The 4719 sqm centre reports a total energy consumption, not accounting for renewable electricity production, of 152,877 kWh/m^2/yr, which – including a health warning, as the building's usage is helped by the fact it wasn't fully rented during monitoring – translates to just 32 kWh/m^2/yr in delivered energy use. According to the US EPA, the average primary energy factor of US electricity is 3.14 – meaning that if the quoted figure is 32 kWh/m^2/yr of delivered energy, it would translate to just over 100 kWh/m^2/yr of primary energy. But, as Bullitt Foundation's president Denis Hayes points out, the electricity generation mix in Seattle is very different to the national average, consisting of 89.3% hydro, 4.3% nuclear and 3.6% wind, with coal, landfill gas and other sources collectively contributing just 2.5%.

When the energy generated by the building's massive solar PV roof is taken into account, the building is a net energy contributor. The 152,877 kWh/m^2/yr total consumed during the building's assessment period for the Living Building Challenge – credited to a combination of the building's efficiency and engagement from occupants – is dwarfed by production of 243,671 kWh, a surplus of nearly 90,000 kWh.

The building exports surplus electricity to the grid for eight months of the year, only becoming a net importer from November to February. "In the four importing months, the hydropower reservoirs are full to overflowing and the utility is delighted to have increased demand that it does not have to export," says Denis Healy. "In the summers – which are getting warmer every year – we are comfortable without the air conditioning found in every other office building in town, and we generate huge electricity surpluses at precisely the time of year and the time of day when the utility most wants them."

The centre sits atop a ground-source heat pump system tapping into 26 wells, each reaching a depth of 121 metres.

All materials used in the building were screened for compliance with the Living Building Challenge's materials red list to restrict toxic chemicals. The building's ecological features are now shared with the public through an ongoing tour program, a public exhibition space, and a number of research projects all managed by the University of Washington's Integrated Design Lab.





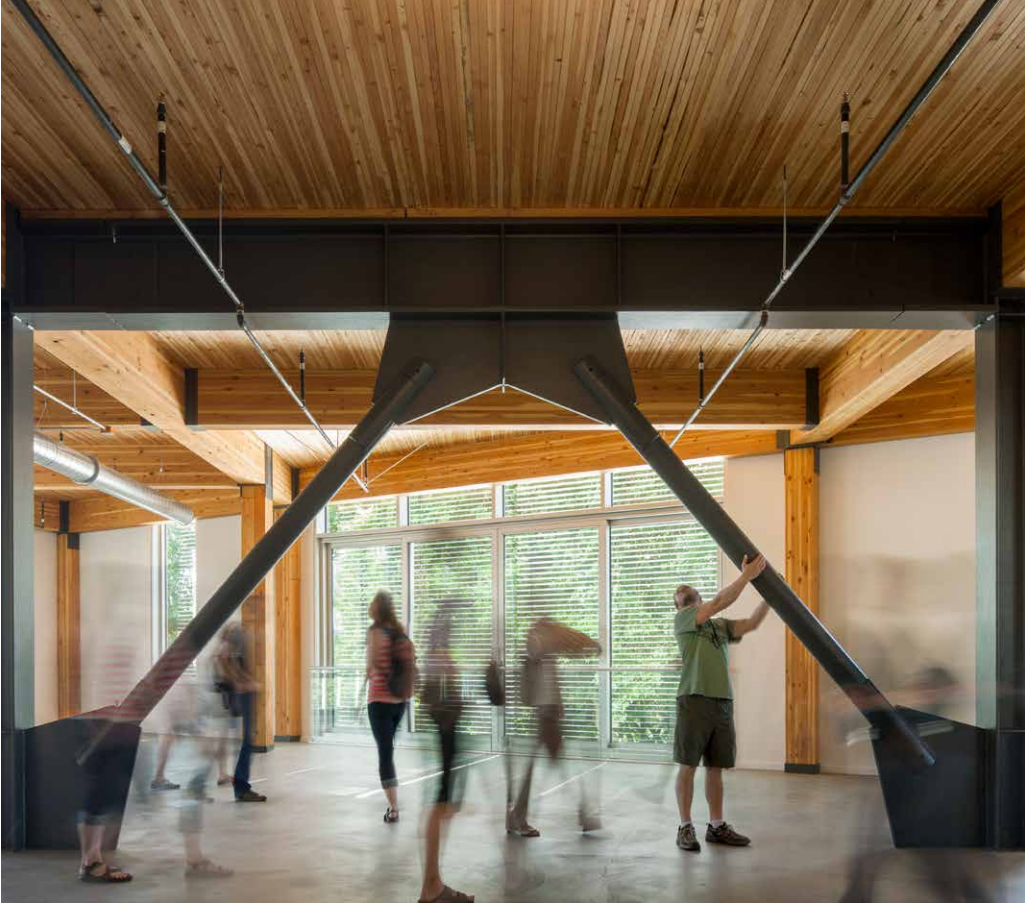


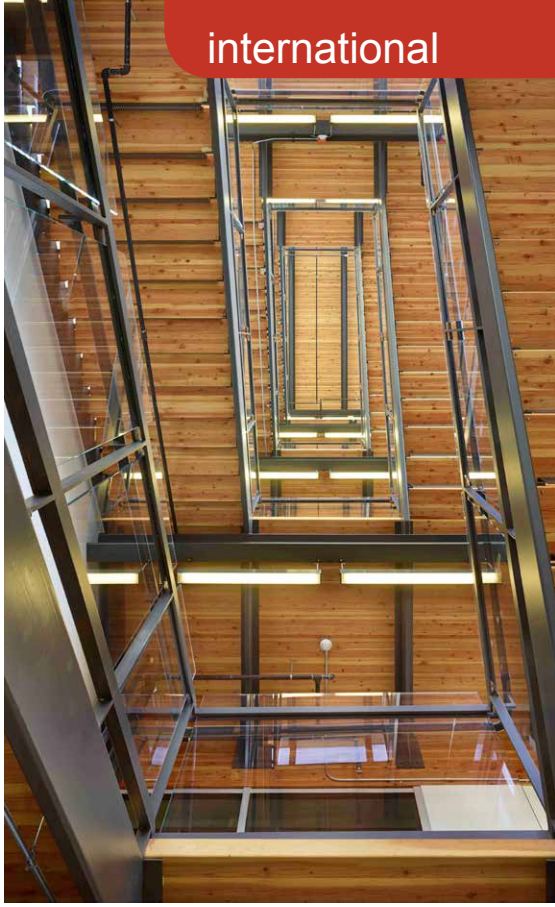
Photos: Nic Lehoux

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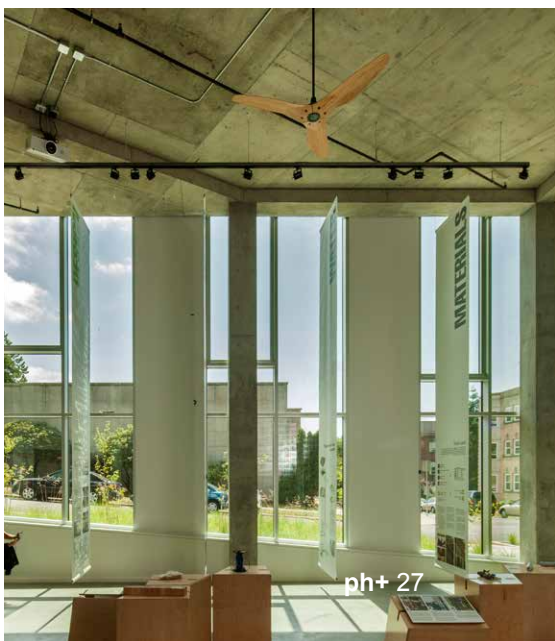
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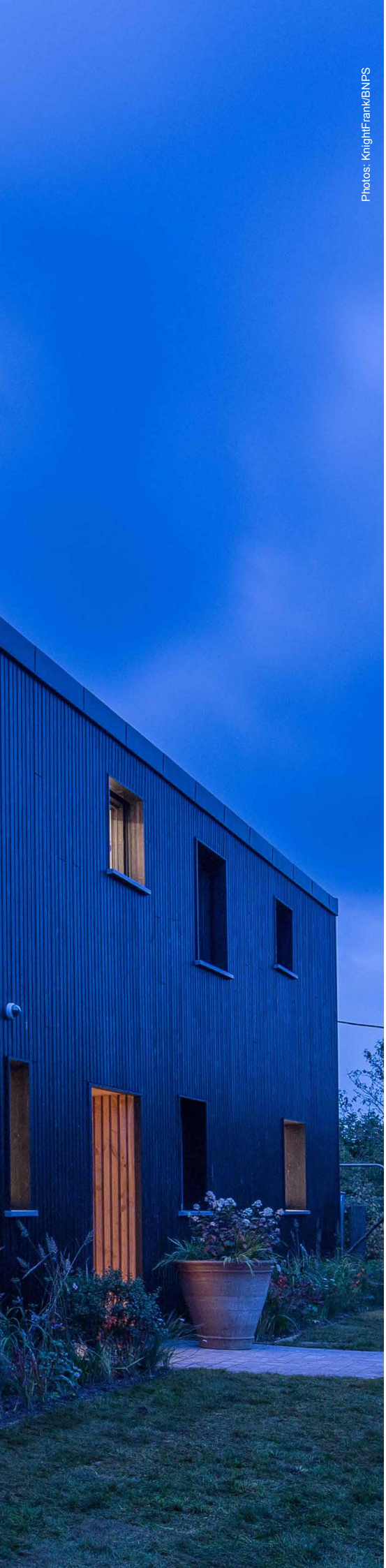



MATERIALS



Simple-yet-*stylish* West Berkshire

passive house that bore a business



Photos: KnightFrank/BNPS

This new timber frame home in the south of England met the passive house standard despite a less-than-optimum orientation, launched a brand new design-and-build venture between its architect and project manager, and embraced a subtle-yet-elegant design that maintains a simple passive house form while drawing inspiration from the local vernacular.

Words: John Cradden

Situated at the edge of the small village of Chieveley in West Berkshire, the Old Water Tower is a simple yet distinctive timber-clad four-bed house currently on the market for £750,000, which is also serving as a showcase for a new passive house based business venture.

Tom Gresford of London-based Gresford Architects had bought a site — previously owned by Thames Water, and which housed an old and ugly water tower — with a view to designing and building a passive house as a commercial development to demonstrate the financial viability of building one-off homes to the passive house standard.

He hired Mike Jacob of Trunk Low Energy Building as his project manager and, although it was their first time working together, they got on so well they have now teamed up to provide a 'one-stop-shop' service for the design and build of passive houses. They have already embarked on two new projects since the completion of Old Water Tower last October — one is about to start on site, while the other is at planning stage.

"We got on so well, and we realised that we both had kind of very similar aims in terms of building passive house and delivering it — and delivering it well, because lots of people don't deliver it very well," said Tom Gresford.

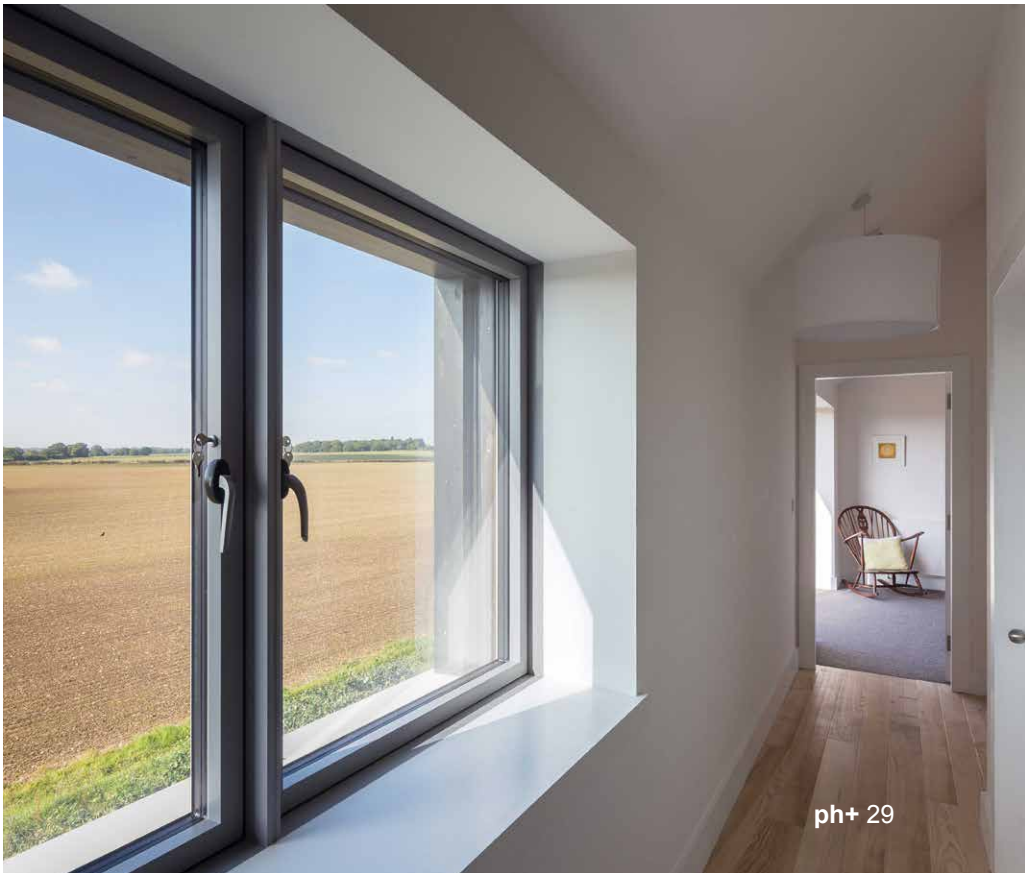
"What we have found since is that lots of people are finding it quite difficult to commission passive house because not many people know how to do it properly. And it's not just the design, it's also the delivery."

They certainly appear to have delivered with this project, a nearly 200 square metre detached, two-storey house built on a budget of £350,000, although that didn't include the costs of demolishing the water tower or the extensive landscaping that the site required — or the nearly £25,000 in Section 106 council fees.

According to Gresford, the house takes its design inspiration from the traditional timber-framed barns of the local area: "On closer inspection it reveals itself as a crisply designed, carefully made, contemporary interpretation of the historic buildings it draws inspiration from."

The timber cladding, although generally more expensive than using render, was less expensive than brickwork in this case and was critical to the aesthetic Gresford was trying to achieve, which he says draws heavily on the local architecture.

Closer inspection reveals that the house is predominantly west-facing, which may not be ideal for a passive house, but Gresford had his reasons for choosing this orientation, not least to take full advantage of the open countryside views from the edge of the village where it is located. ▶



"Of course it's ideal if a house faces south, but if there's a reason such as this one, which is where you have fantastic views to the west and also very close neighbours to the south that we didn't want to be overlooking, then it's worth doing," he says.

Fenestration is carefully arranged along the west elevation to maximize the views, whereas the east and north elevations have small windows to reduce heat loss and to avoid overlooking adjacent houses. The garden to the west has been raised by 400mm above internal floor level to allow full views of the landscape while eating and sitting outside.

The southern side of the house has large windows at ground floor level, opening onto a large paved terrace area. If you were wondering about what look like very randomly placed small windows at the first floor level, they are intended to "offset the formality of the facade, and are inspired by the vernacular openings in dovecotes". The windows are set at high level to avoid overlooking neighbours.

Inside, the ground floor layout is designed around two living areas separated by a hallway and staircase and a utility room. There are no doors except for the bathroom and utility rooms. The four bedrooms have distinct characters and all but the guest room (which has an attic with storage and plant above it) take advantage of the roof form by opening up to the internal apex of the roof to create a feeling of space in a relatively tight floor plan.

The two bathrooms, placed on the east side of the building, where the requirement for small windows fits neatly with the principle of reducing easterly glazing to prevent heat loss, also open up into the roof pitch.

According to Gresford, one of the keys to keeping the costs down on this six-month build was the pre-fabricated timber frame, which was produced by Irish passive house industry stalwarts MBC Timber Frame and erected in just two weeks. "That takes a huge amount of money out of the equation in terms of the overall build time," he says. Ideally MBC would have also fitted the windows (from Ideal Combi's Futura+i aluminium range) as well but they arrived too late to slot into their assigned build time.

The house isn't on mains gas, so a Worchester 12i LPG gas boiler provides the space and hot water heating, while a Paul Novus 300 MVHR heat recovery system handles the ventilation side. The motorised external blinds are courtesy of Irish passive house firm Young Design Build and are critical for preventing overheating in the summer.

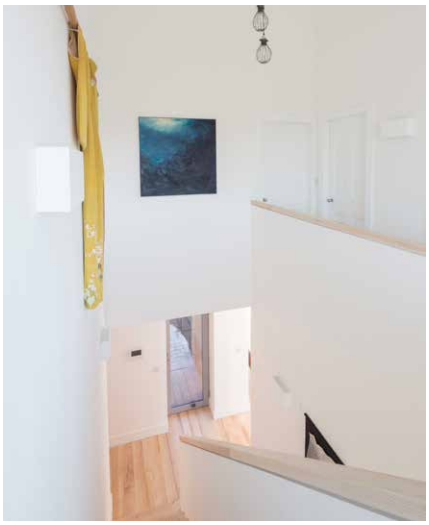
Gresford says the savings in cost and time achieved by things like the pre-fabricated timber frame "generally outweigh any extra costs for things such as the MVHR or external shading", while triple-glazed windows are no more expensive than double-glazed.

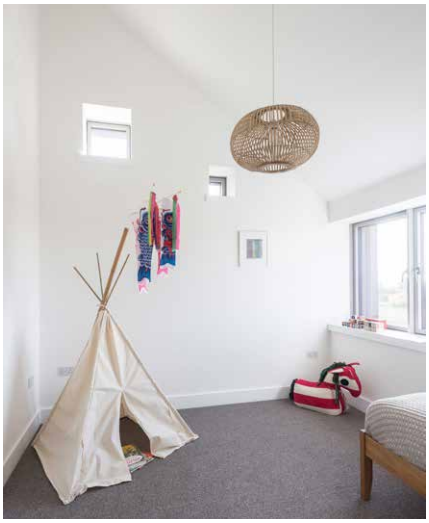
"We went with MBC [Timber Frame] because they basically deliver a guarantee. They guarantee the airtightness, the U-values and the thermal bridge-free design. So those are three very important parts of delivering a passive house." ►











So while they had no intention of re-inventing the wheel in terms of delivering this particular project, there were still some design challenges to overcome.

Although there were good reasons for the house to face west, Gresford's colleague and the company's passive house designer, Francisco Cerezuela, says designing around this orientation but also taking into account the relatively high heat loss form factor (3.29) was "quite challenging". Once the form factor – the ratio of external surface area to floor area – is over three, achieving the passive house standard becomes noticeably more difficult.

"So we had to push for the thermal envelope," he says, which led him to beef up insulation levels substantially – 400mm of bonded bead for the walls and 500mm for the roof – and using Springvale Ecobead insulation for better U-values compared to a lesser bead. Similarly, 400mm of EPS insulation was specified on the concrete slab – using the passive house certified system by yet another two Irish companies involved in the project, Kore and Viking House. Irish involvement in the project didn't end there, and extended to SmartPly OSB and Medite Vent sheathing panels from Coillte Panel Products, roofing membranes from Irish distributor Partel, not to mention sustainable structural engineer Hilliard Tanner and thermal bridging authority Andy Lundberg.

Aside from the advantages of working with people with whom you have a strong and symbiotic working relationship, project manager Mike Jacob says his and Tom's new "one-stop-shop will ultimately improve the construction methods themselves".

Their next project, which they are about to start construction on at the time of writing, is about two and a half times the size of the Old Water Tower, and it will use the exact same timber frame system from MBC and will also be timber clad, though there's no danger that it might resemble a carbon copy of the house in Chieveley.

"The market we're in, we're very much looking to serve one-off clients who are after bespoke, unique houses, and therefore each project will still be different from the last, but the efficiencies will come from more discrete areas rather than them all looking the same."

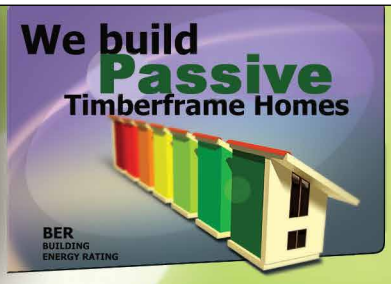
But Mike and Tom are clearly quite fond of Old Water Tower. "It was a big contrast with a lot of the jobs I do for clients, where I'm building their dream house and it tends to be complicated and unusual. This is a simple, modest design but at the same time it's crisp and modern in its style. It's not a boring box, it's got elements of style that are interesting without being ostentatious," says Mike Jacob, who's not alone in this view. The house has been nominated for RIBA South & Southeast awards and for RICS Southeast awards under the residential and design through innovation categories.

Tom describes returning to the new passive house after the last Christmas break, having spent so much time in it prior to the festive season. Even though it had been empty over that period, "it was amazing the atmosphere in the house, it just felt so lovely. You walked in and the air temperature was perfect, nice and fresh. You just don't get that feeling with other houses." ►

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(clockwise from top left) The ground floor features 400mm Kore EPS insulation under 100mm reinforced concrete slab; a Siga Majpell vapour control and airtight layer protects the building against excessive moisture penetration; the 45mm service cavity fulfilled with mineral wool insulation; airtight detailing to prevent the joist ends causing avoidable infiltration; Ampatop Protecta plus membrane fitted to the roof; the timber frame structure coming together

SELECTED PROJECT DETAILS:
Architects: Gresford Architects
Project Manager:
Trunk Low Energy Building
Passive house certifier: Warm
Timber frame: MBC Timber Frame
Insulated foundations: KORE
Structural engineer:
Tanner Structural Design
Glazing: Ideal Combi
MVHR: Green Building Store
General fit out & contractor: Husker Ltd
Electric contractor: Nightingale Electrical
Building society: Ecology Building Society
Thermal bridge assessor: Passivate
M&E consultant: Crofton
Landscape architect:
New British Landscapes
Airtightness products: Siga
Roofing membrane: Partel
OSB & sheathing boards:
Coillte Panel Products
Wall & roof insulation: Springvale EPS
Mineral wool insulation: Knauf
Thermal blocks: Foamglas

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The digital magazine is available to subscribers on www.passive.ie

PROJECT OVERVIEW

Building type: 188.5 sqm detached two-storey timber frame house

Location: Chieveley, RG20 8TP, England

Completion date: October 2015

Budget: £335,000

Passive house certification: Certified

Space heating demand (PHPP): 13.8 kWh/m^2/yr

Heat load (PHPP): 11 W/m^2

Primary energy demand (PHPP): 104 kWh/m^2/yr

Environmental assessment method: Code For Sustainable Homes – Level 4

Airtightness (at 50 Pascals): 0.58 ACH

Energy performance certificate (EPC): Energy Efficiency Rating B 84 & Environmental Impact (CO_2) Rating B89

Thermal bridging: Nail plate to wall – Chi-Value = 0.00357 W/(mK) – 3.1% Total transmission heat losses. Nail plate to roof – Chi-Value = 0.00357 W/(mK) – 0.8% Total transmission heat losses. Perimeter wall/floor junction — Y = 0.030 W/(mK) – 1.0% Total transmission heat losses. Raft insulation downstand – Y = 0.070 W/(mK) – 0.8% Total transmission heat losses. SVP – Y = 0.185 W/(mK) – 1.0% Total transmission heat losses

Ground floor: 400mm KORE Floor EPS100 white insulation (EPS300 to perimeter) under 100mm reinforced concrete slab. **U-value:** 0.092 W/m^2K

Walls: 34mm Piveteaubois Pulso vertical timber cladding on battens and counter battens, on Glidevale Protect TF200 breather membrane, on 12mm Medite Vent MDF panel, on 400mm twin timber stud with Springvale Ecobead Platinum insulation, on Siga Majpell vapour control and airtight layer, on 15mm SmartPly OSB class 3 board, on 45mm service cavity fulfilled with mineral wool insulation, on 12.5mm plasterboard with 3mm skim coat finish. **U-value:** 0.085 W/m^2K

Roof: Rheinzink Prepatina graphite grey double standing seam onto 22mm plywood sheeting, on 44mm battens fixed through to joists, on Ampatop Protecta plus roof membrane, on 500mm twin timber stud warm roof fulfilled with Springvale Ecobead Platinum insulation, on Siga Majpell vapour control and airtight layer, on 15mm OSB class 3 board, on 45mm service cavity fulfilled with mineral wool insulation, on 12.5mm plasterboard with 3mm skim coat finish. **U-value:** 0.070 W/m^2K

Windows: Ideal Combi Futura+i triple-glazed aluminium turn/tilt and fixed windows, Ideal Combi Futura+ sliding doors, Ideal Combi Nation doors. **Average G-value:** 0.49. Average **Ug-value:** 0.58 W/m^2K. Average window **U-value:** 1.00 W/m^2K.

Heating system: Worcester 12i LPG boiler supplying one radiator to each room and towel rail to each bathroom. 300L horizontal hot water cylinder

Ventilation: Paul Novus 300 MVHR heat recovery ventilation system – 88.7% final effective heat recovery efficiency.

Shading: Young Design Build motorised external blinds providing 38% of reduction factor Z for temporary sun protection.

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Photos: Paul Starr Photographer

"Even though the house sits right under a major flight path for Stansted Airport, it's still quiet inside."

Hastoe Scheme *adds to passive affordable housing trend*

With a number of trailblazing housing associations and councils building social and affordable housing schemes repeatedly to passive standards, the notion that the world's leading low energy building standard is the preserve of the well-off doesn't stand up to scrutiny, as Hastoe's latest Essex passive house scheme demonstrates.

Words: Lenny Antonelli

This new development of 14 units in Essex marks the latest in a long line of passive house projects for Hastoe Housing Association, now one of the UK's most prolific passive house developers.

The project at Hatfield Heath features 11 units that are certified to the passive house standard, and is the latest in a long line of passive house projects by Hastoe and architects Parsons + Whittley.

Having carried out a local housing needs survey, Hatfield Heath Parish Council then invited local housing association the Hastoe Group to act as a developer for a new affordable housing scheme.

The team found a rural exception site — a plot where private housing is not allowed, but affordable or social housing can apply for planning — on the edge of the village, and brought on board leading Norfolk-based passive house architects Parsons + Whittley.

"The Parish Council was very supportive [of passive house]," says Ulrike Maccariello, development manager with the Hastoe Group. "They really appreciate the high sustainability level."

She adds: "The scheme also facilitates some allotment spaces — that was really important for the parish."

Parsons + Whittley have history with Hastoe now — the firm has designed about 50 passive house projects for the association across various schemes.

Hastoe currently builds 20% of its new housing units to the passive house standard, and has built 105 passive units so far, with 58 more on the way, making it one of the UK's leading passive house developers.

Hastoe builds the other 80% of its units to Code for Sustainable Homes level four, but with the demise of the code, the association is currently looking to adopt a new standard for the majority of its new build.

Parsons + Whittley has also designed units for Hastoe to the AECB Silver standard. Architect Chris Parsons praises Hastoe for the association's "genuine attempts to lower energy use and preserve comfort".

At Hatfield Heath, the walls of the 14 units are of simple lightweight aircrew block construction with external insulation, with internal wet plaster forming the airtightness layer.

"We decided that we would go for masonry again. I quite like the thermal mass, and I think it's a cost-effective method of delving the thermal performance we need," says architect Chris Parsons.

"It's skills that are available locally, materials that are available locally, and a technique that we used before that worked."

The ground floor is a raft foundation insulated with 400mm of Dow Floormate XPS, while the roof is insulated on the flat with 500mm of Knauf Earthwool. Windows are triple-glazed passive house Internorm timber-aluminium units, supplied and fitted by passive house ▶

specialists Ecohaus Internorm.

Perhaps not surprisingly considering the experience the team has in building to the passive house standard, the build went fairly smoothly.

“It went pretty much to plan if I’m honest,” Parsons says. “We had a little bit of a struggle with some airtightness, but we went back and sorted it out.”

It was Hastoe and Parsons + Whittley’s second time working with contractor DCH Construction too.

”They’re really very conscientious contractors who were keen to learn, keen to understand,” says Parsons.

The houses are ventilated by Zehnder MVHR units, and Parsons says there was some discussion among the team about whether to install rigid or flexible ducting, with Chris Parsons favouring rigid Lindab ducting, even though it required a more careful design and construction process.

“I just feel that if you’re burying ducts in the structure of the building, you should probably use the best product you can,” he says. “That’s not to say plastic flexible ducting is necessarily a bad thing.”

Specifying rigid ducting posed a design challenge though, Parsons says. “How do you design your space joists so you can feed rigid ducting in, and when do you install it during the construction process?”

Ultimately the team put all the long ducting runs into the joists during construction, then came back at the end of the project to connect all the ducts up.

The houses are all heated by Baxi combi gas boilers delivering to, in most instances, single radiators downstairs and towel rails upstairs in the passive house units.

“We just decided it would be very good to keep things, especially the M&E, very simple,” said Maccariello. “In the summer you turn it down, and in the winter you turn it up to a temperature that you’re comfortable with, and then you just leave it.”

“People are quite used to having gas central heating, even though we only have two or three radiators in the house — it’s easy.”

On a previous scheme Hastoe had specified a more complicated gas heating set up, with all heat delivered through the MVHR, and found it more difficult to find local engineers who could service the system.

Chris Parsons specified, he says, the simplest thermostat he could find. “All I wanted was something that goes from 0C to 30C and lets people turn the dial.”

Four of the houses are being monitored for temperature, relative humidity, CO_2 and energy consumption, but the data had yet to be processed at the time of writing.

Parsons says: “This is probably the first scheme in which we did some detailed induction or handover for tenants.”

This involved spending 45 minutes to an hour with each tenant to explain the principles of a passive house, the ventilation, the heating system and so on.

“A lot of them have no prior knowledge of passive house, or any form of sustainable housing,” Maccariello says. “It’s basically to give them the knowledge to get the best out of their new home.”

Tenants moved into the houses about a year ago. Maccariello says feedback from has been very positive so far. “At Hatfield Heath they have sort of just gone through their first winter. It hasn’t been a particularly harsh winter, but there wasn’t any negative [feedback].The residents are generally very happy in their homes.”

One thankful and unintentional by-product of building to the passive house standard is that, even though the house sits right under a major flight path for Stansted Airport, it’s still quiet inside.

“With the triple-glazed windows, you can’t really hear the airplanes inside the houses,” Maccariello says.

This was by accident more than design though, she says. “Nobody thought about it. We did a time lapse film, and when we did some of the interviews on site, we had to stop filming every few minutes because another airplane came over. That’s when we realised it’s right under the flight path.”

Hastoe now has extensive experience building to passive and other green building standards, but Maccariello says it’s difficult to tease out how much more passive costs compared to the mediocre energy efficiency demands of English building regulations.

“We haven’t done a cost comparison exercise for some time. I would think it’s probably around 10% [extra] or below, but we haven’t done a proper analysis.”

She says the thing Hastoe likes about passive house, because of the certification process, is certainty of performance. With the Code for Sustainable Homes, you can put extra resources in and not be sure what the exact benefits to residents are. But with passive, he says: “You have lower energy bills, but you’re just comfortable.”

“The main driver for us to deliver passive house is fuel property in rural areas,” she says. “It’s really important to us that our residents can afford to live comfortably.” ▶

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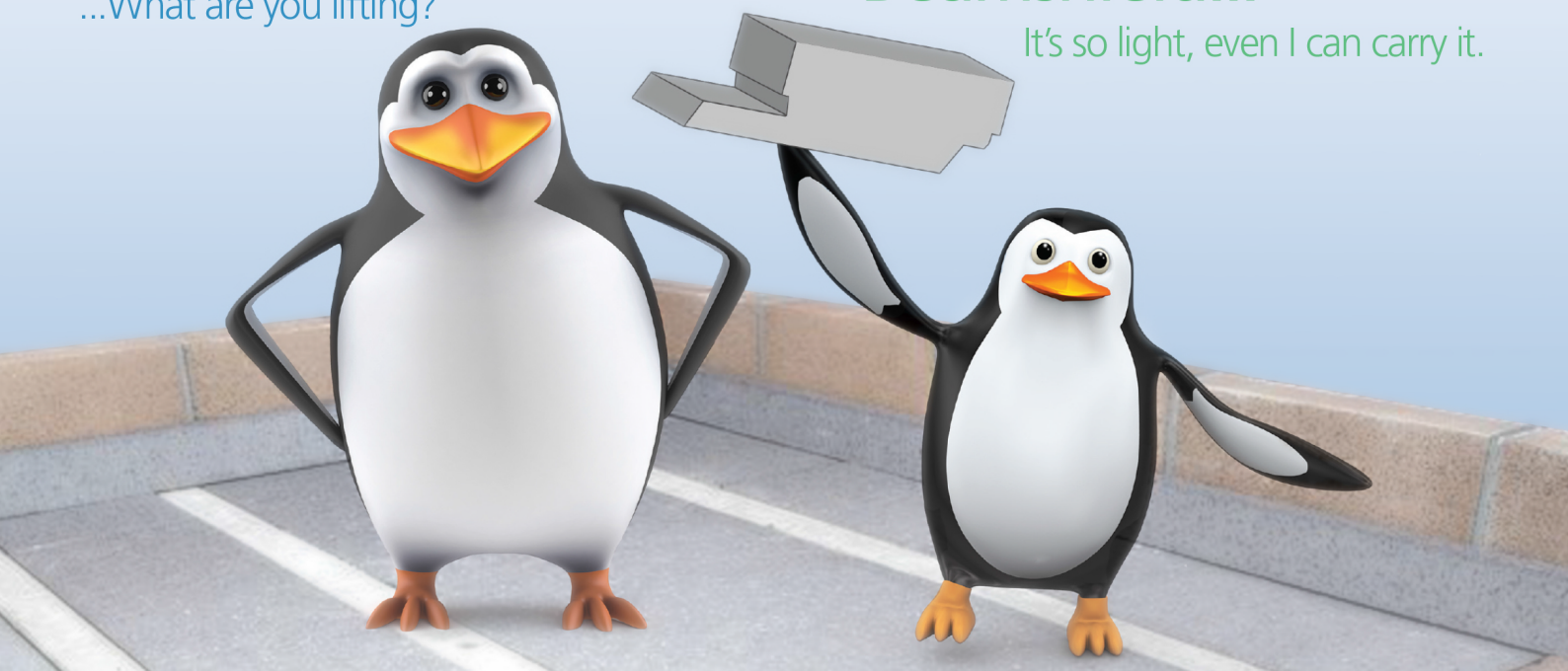


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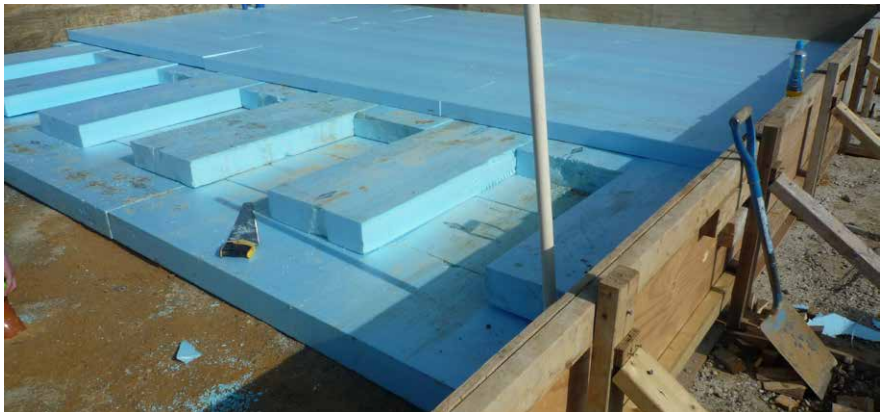
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(left, from top) The ground floor is insulated with 400mm of Dow Floormate XPS; the walls are of simple lightweight Airtec block construction and are externally insulated with Lambdatherm graphite-enhanced EPS; (below) the external insulation surrounds the Internorm windows, which are triple-glazed timber-aluminium units; (next page) the houses are ventilated by Zehnder MVHR units, and rigid ducting was specified even though it required a more careful design and construction process. The team put all the long ducting runs into the joists during construction, then came back at the end of the project to connect all the ducts up



SELECTED PROJECT DETAILS:
Client: Hastoe Housing Association
Architect: Parsons + Whittley Architects
Contractor: DCH Construction
M&E engineer:
Engineering Services Consultancy
Civil engineer: Donald Hall Associates
Structural engineer: Ken Rush Associates
Quantity surveyor: AECOM
Mechanical contractor:
Bentley Mechanical Services
Electrical contractor:
Kim Daplyn Electrical Services
Passive house certifier: MEAD Energy & Architectural Design
Airtightness tester: Anglia Air Testing
Wall insulation: SPS Envirowall
Additional wall insulation: Dow
Thermal breaks: Ejot
Roof insulation: Knauf
Floor insulation: Dow
Airtightness products:
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Windows: Ecohaus Internorm
Gas boiler: Baxi
Radiators: Stelrad
MVHR: Zehnder ▶

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PROJECT OVERVIEW

Building type: 14 affordable housing units across three terraces in rural Essex, 11 of which are built to the passive house standard

Location: Broomfields, Hatfield Heath, Bishop's Stortford, Essex

Completion date: February 2015

Budget: £1.94m

Passive house certification: 11 units certified

Other environmental certification: Code for Sustainable Homes Level 4

Space heating demand (PHPP): 14kWH/m^2/yr

Heat load (PHPP): 9 W/m^2

Primary energy demand (PHPP): 93 kWh/m^2/yr

Airtightness (at 50 Pascals): All units achieved 0.6 air changes per hour

Energy performance certificate (EPC): B (87)

Ground floor: 300mm concrete raft with 400mm XPS structural insulation and sub-base. **U-value:** 0.085 W/m^2K

Walls: Envirowall silicone render system or Siberian Larch cladding on 285mm Lambdatherm 70 graphite-enchanced EPS insulation (thermal conductivity 0.032W/m^2K), on Thomas Armstrong AirTec 'Standard' Wall Block (thermal conductivity 0.11W/m^2K), with gypsum based two-coat plasterwork internally for airtightness. **U-value:** 0.106 W/m^2K

Roof: Concrete interlocking tiles on battens on vapour permeable underlay on timber roof trusses, with 500mm Knauf Earthwool Loft Roll on the flat. 15mm Gyproc plasterboard to internal ceilings, with two-coat lightweight plaster system for airtightness. **U-value:** 0.91 W/m^2K

Windows: Internorm HomePure HF310 triple-glazed timber-aluminum composite windows and doors. g-value: 61%, **Overall U-value:** 0.87.

Heating system: Baxi Duo-Tec Combi Boiler GA 20KW natural/mains gas boiler, with one radiator downstairs and one towel rail upstairs to passive house units. Radiators sized for low temperature operation.

Ventilation: Zehnder ComfoAir CA200 mechanical ventilation system with heat recovery, Passive house Institute certified to have an efficiency of 92%.











Photos: Imageworks

Kildare passive house uses unique

oak frame construction





This brand new light-filled passive house set in the countryside of north Kildare was inspired by local farm buildings, and features a striking and exposed oak-framed structure.

Words: Lenny Antonelli

This new passive house in rural Kildare hasn't just met the passive house standard, it's done so while embracing a beautiful oak-framed structure that sets it apart from your average low energy timber-framed house. The Irish oak frame was the vision of client Matt Sheehan and his wife Olwyn, and was integral to the project from the outset.

Matt says that the oak frame, "was probably one of the most important aspects of the house that we had envisaged right from the start. The idea really planted in our minds after we visited Claregalway Castle," he says. "I went to a conference that was hosted there and the castle had just been restored."

The castle, in Co Galway, had just been restored with an oak frame by carpenter Paul Price of Woodrights. Matt then asked Paul to come on board and build an oak frame for his own house. "I quite like the design of all the joints, the physics of how the joints work," Matt says of his preference for oak. "I quite like the geometry side of it, and it looks pretty amazing, it looks beautiful. It would convey a sense of extreme robustness and durability in the feeling of the house.

But Matt and Olwyn also knew that their house needed to be a home. "You still want to be able to make it a house, it can't just be a frame to look at," Matt says. "I wanted it to be a home that felt welcoming — and I know that's an ethereal or hard to define term."

The couple didn't set out with the aim of building a passive house. But they knew they wanted an oak-framed house built with structural insulated panels (or SIPs, a fairly common and logical way of filling in oak-framed walls and roofs), good U-values, airtightness, and heat recovery ventilation. Matt says: "We wanted to build a well-designed house that was designed for the way we wanted to live, but also efficient in terms of the use of space and the orientation, and the use of energy."

Matt had read about local low energy builder Pat Doran Construction in Passive House Plus, and brought the father-and-son team of Pat and Paul Doran on board. "He read about us in the magazine, and he lives close by," says Paul Doran. "So he contacted us and he met with us a good few times, and he just talked about what he wanted to achieve and what he wanted to do."

Pat Doran Construction advised Matt that it wouldn't take much extra to get their design to meet the passive house standard. "We realised how close we were with our original plan, and we only needed a small tweak to get it across the line. And it seemed like it was worth going that extra mile," Matt says. For him, passive house just means, "good sensible design that you would do anyway if you were trying to construct a house as best you could."

But sticking with Matt and Olwyn's vision for an oak frame required perseverance and forethought. The couples' first architect ►



had talked them out of the idea of building with oak, and in fact that first design wasn't really suited to an oak frame anyway, so the original planning application was for a house without one. But Matt and Olwyn ultimately decided that an oak frame was integral to what they wanted, so they hired a new architect, and went back for planning permission a second time — this time for an oak-framed house.

The design demanded detailed co-ordination between the contractor, the carpenter, the SIP supplier, the engineers, and so on. "So there was an enormous amount of coordination," Paul Doran says. The structural engineer wanted both the oak frame and SIP structure to be individually self-supporting.

The use of an oak frame constrained the size and shape of the house, but the need for a compact dwelling also lent itself to meeting the passive house standard. "The oak frame frames the floor plan — the two have to go together and respect each other," says oak frame carpenter Paul Price.

He adds that there is simply no way to make an oak frame work for some house designs, and even if it was possible, it wouldn't look good. Price sources all of his oak from Ireland, though he says the supply can be unreliable. "It was great to have a client who was so into it, and who wanted to get things right," he adds.

Matt produced floor plan drawings himself, but ultimately had to keep going back and rejigging things to make the design fit with the frame. The original designs also made no provisions for a plant room in the tight space, which meant another rethink was needed.

"The client was extremely passionate about the project, and put in an enormous amount of effort into it," Paul Doran says. "I think there were ten first floor plans before we finally found one that worked." Achieving airtightness required a lot of forethought and effort too. "Every time we found a solution it caused a problem somewhere else."

The intermediate floor was wrapped in an airtight membrane to ensure it was sealed where it met the external walls, and the walls themselves were lined inside with an airtightness membrane. Even though SIPs are inherently airtight, Paul Doran wanted to ensure it met the passive house target of 0.6 air changes per hour. "If you're going for 0.6, you couldn't take the risks," he says.

Ultimately all of the forethought and planning proved its worth, and the house got 0.3 air changes per hour on its first airtightness test, and 0.4 on its final test. "It is a lot easier [to achieve airtightness] with timber frame — the fact you have a membrane going from the floor on all the walls and all the ceilings," Paul Doran says.

The SIP panels, manufactured by Galway-based specialists SIP Energy Homes are composed of two layers of OSB that sandwich 150mm of XPS. This layer of insulation continues down to the perimeter of the slab to eliminate thermal bridging here. Both the walls and roof also have Gutex wood fibre board to the exterior of the structure for further insulation.







Paul Doran says: "There is continuous insulation between the SIP panels and the roof, and the Gutex on the walls meets the insulation in the foundation system, and then runs up and meets the Gutex in the roof." This means the house is, in fact, wrapped in two continuous layers of insulation.

Doran is clearly proud to have achieved this, and an excellent airtightness result, on such a singular and challenging project. "It was very unique, because there were a lot of constraints on it, with the oak frame, with the SIPs, the size of the house and then trying to achieve the airtightness," he says.

The house is heated by a Daikin air source heat pump, delivering to radiators downstairs and upstairs in the bedrooms. The team was originally just going to put rads downstairs, but decided to put some in the bedrooms for extra security and comfort, as the vaulted ceilings here are quite high. Meanwhile a Zehnder 350 ComfoAir unit processes heat recovery ventilation, and a small solar photovoltaic array too is due to be fitted imminently as Passive House Plus goes to press.

"Since we've built it and been in it, we haven't needed the heating on," Paul Doran says.

Matt and Olwyn had yet to move in at the time of going to print, but Matt is — so far — thrilled with how the house turned out. "I think we did a pretty good job of showing off the frame," he says. "At the staircase you can see all the way up to the ridge beam." Meanwhile the bedrooms all open up to vaulted ceilings. ▶



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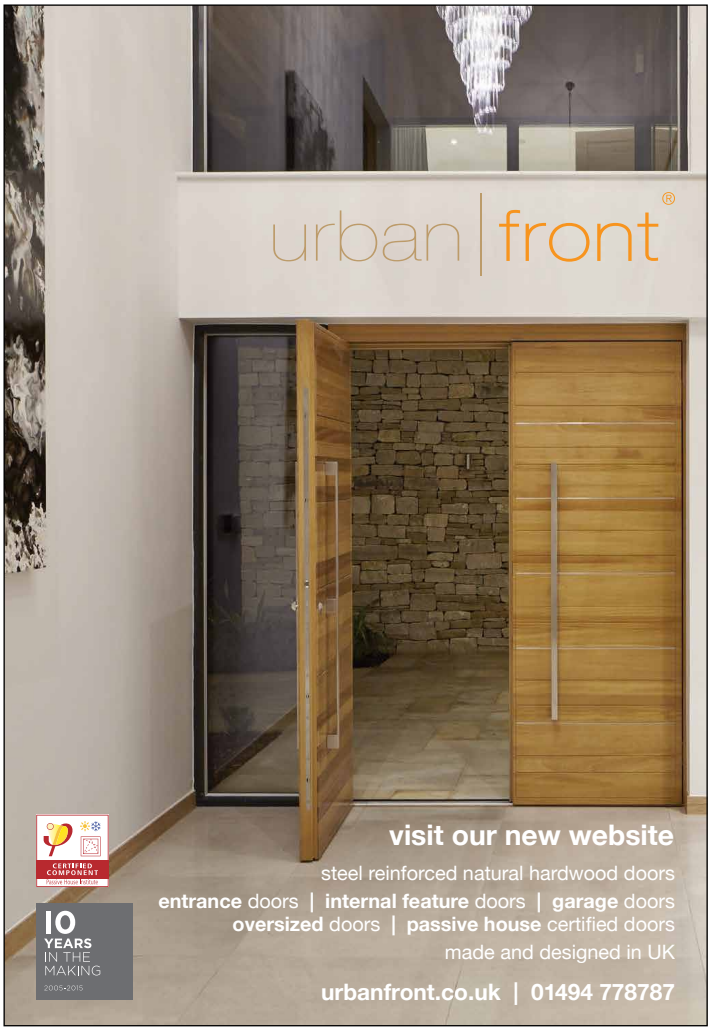
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Having rented all their lives, designing the house provided a chance to create the house they wanted. The compact form of the house also suits its rural context. "It suits the countryside. It's a barn shape, it's in an agricultural setting," Matt says. The walls are clad externally with cedar, continuing the wood feel to the exterior.

Ultimately the house can only prove its worth once Matt and Olwyn have lived in it for a while. But presuming the house is as comfortable, healthy and energy efficient as any certified passive house, it looks like they — along with the whole team behind the project — have produced a rather unique and beautiful new low energy home.

Want to know more?

The digital version of this magazine includes access to exclusive galleries of architectural drawings.

The digital magazine is available to subscribers on www.passive.ie

SELECTED PROJECT DETAILS

Architect: Martin Murphy Design & Build
Civil & structural engineer: Duffy Chartered Engineers
Oak frame: Woodrights
SIP system supplier: SIP Energy Homes
Contractor & project management: Pat Doran Construction
BER: Greenpro Energy Consultants
Mechanical contractor: David Gaffney Heating & Plumbing
Electrical contractor: Frank Knight Electrical
Airtightness testing: Greenpro Energy Consultants
Roof insulation & airtightness contractor: Baker & Co
Passive slab: Kore
Windows & doors: Munster Joinery
MVHR: Zehnder, via Flynn Heat Recovery
Solar PV contractor: Base Engineering
Cedar cladding: Machined Timber Services
Screeds: Renobuild
Plasterboard: Gyproc
Airtightness products & wood fibre insulation: Ecological Building Systems
Carpentry: Michael Quinn Carpentry
Roofing: Euroclad
Heat pump: Daikin
Solar PV: Solarworld



(below, clockwise from left) The building's oak frame under construction and exposed in the finished home; the make-up of the external walls thermal layers coming together with structural insulated panels, studded out externally to include 100mm of Metac; beneath 80mm Gutex wood-fibre boards









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"I quite like the geometry side of oak, and it looks pretty amazing, it looks beautiful."





PROJECT OVERVIEW

Building type: 160 square metre detached two-storey oak frame house

Location: Naas, Co Kildare

Completion date: March 2016

Budget: Not disclosed

Passive house certification: Pending

Space heating demand (PHPP): 17 kWh/m^2/yr

Heat load (PHPP): 10 W/m^2

Primary energy demand (PHPP): 118 kWh/m^2/yr

Airtightness: 0.4ACH at 50 Pa

Energy performance coefficient (EPC): 0.272

Carbon performance coefficient (CPC): 0.283

BER: A2 (45.29 kWh/m^2/yr)

Thermal bridging: SIP wall panels on concrete floor slab — 150mm XPS continuous insulation with SIP roof panels. Concrete floor slab on insulated foundation system (300mm of EPS) (Kore Passive Slab). 80mm of upstand of Kore Passive Slab in floor in full contact with 80mm of Gutex on outer stud wall of SIPs in full contact with 35mm of Gutex on roof; full wrap of insulation all around the house. Windows thermally broken.

Ground floor: Raft foundation insulated with 300mm EPS. **U-value:** 0.10W/m^2K.

Walls: Oak-framed walls, 22m Cedarwood cladding externally, followed inside by 50 x 25mm treated battens on 80mm Gutex woodfibre board, 100 x 44mm stud filled with 100mm of Isover Metac mineral wool, 15mm taped and sealed OSB SIP insulated with 150mm XPS insulation, and pro clima airtight DM membrane internally with 50 x 25mmm battens for an uninsulated service cavity and 15mm Gyproc Rigidur board internally. **U-value:** 0.12 W/m^2K.

Roof: Oak framed roof, Euroclad Vieo Edge metal sheeting on breathable roofing underlay externally, on 18mm OSB, on 50mm x 25mm treated battens, on 35mm Gutex on SIP Panels (15mm OSB, 150mm XPS, 15mm OSB) and pro clima DM airtight barrier internally with 50 x 50 battens to form a service cavity insulated with 50mm Metac. **U-value:** 0.14 W/m^2K.

Windows: Munster Joinery Passiv triple-glazed timber aluclad windows, Passive House Institute certified. **Overall U-value** of 0.82 W/m^2K.

Heating system: 4.5 Kw Daikin Altherma air-to-water heat pump (SPF: 389% for space heating, in accordance with IS EN 14825) supplying 2 rads downstairs, 3 rads upstairs, hot water and towel rads.

Ventilation: Zehnder 350 ComfoAir heat recovery ventilation system — Passive House Institute certified to have heat recovery rate of 83%.

Electricity: 2 panel SolarWorld PV system to be installed.

Photos: Imageworks



"I can't believe how low my bills are. I filled the gas tank when I moved in a year ago. I've only turned on the heat about three times, I just don't need it."

Affordable passive scheme that *beggars belief*

It may sound too good to be true, but a new scheme of semi-Ds in Co Wexford proves that passive houses can be remarkably affordable to buy – and that's with net zero heating and hot water costs, and the soundproofing levels of a cinema.

Words: John Hearne







On a cold, wet winter's day, four weeks before Christmas, builder Michael Bennett broke ground on his new site – Madeira Oaks – in Enniscorthy, Co Wexford. Bennett had been building low energy houses since 2007, and by this time, he was the veteran of several high profile passive builds, including former European Parliament president Pat Cox's house in Blackrock, Co Dublin and the passive development at Grange Lough in Rosslare, Co Wexford, both of which featured in this magazine.

Madeira Oaks however, would be different. Not only would the twelve houses in the development be certified passive, they would also be affordable.

"I've had this idea for years that first time buyers should be able to afford passive houses," says Bennett. "I didn't see any reason why they shouldn't. We've put a lot of research into it over the last few years, we got our planning there last year, and now we're up and running."

Three of the houses which will be completed this year have already been sold. The price? €170,000 a piece, for three-bed semi-Ds of 102 sqm each.

"They're coming with a full passive house certificate, they're coming with a Homebond cert, and they're A2 rated. I can guarantee you one thing, there's nowhere in the UK or Ireland where you'll buy a fully certified house passive house with a Homebond guarantee and an A2 rating for that money."

These houses mark the culmination of years of research and building experience, says Bennett. He cites the expertise of the trained crew he's worked with throughout that time, plus the dedication and support of one of the country's pre-eminent passive architectural practices, MosArt, as vital in realising his long-held dream.

"It's all about planning with passive housing... That's the secret, your pre building work. You have to be sure of where you're going before you go the journey."

Donal Mullins of Shoalwater Timberframe, who has also worked with Bennett throughout this time, says that one further ingredient has been vital in keeping costs down: simplicity.

"Labour costs are the big issue," he says. "The less hours you spend on site, the less hours you spend in the factory, the lower your costs. But those houses are very simple. We went through them with Bennetts and MosArt, we pared back the design and kept everything as simple as possible. That was the name of the game."

Interestingly, despite the fact that Bennett's ambition centred on first time buyers, all three of the first phase houses were sold to retired women.

When you think about it, he points out, that makes perfect sense.

"The first big attraction is there's no oil lorry pulling up, no big cheque to be written for oil, no oil burner to be serviced, there's no coal lorry with coal, turf or sticks pulling up, there's no fireplace to clean out, there's no ashes, there's no chimney to get cleaned. There's a lot less hardship in a passive house."

Then there are the comfort levels. Ray McGahern moved into his Bennett-built low energy house four years ago. Prior to that, he'd been living in a 60s era cavity block house on the same site.

"I well remember sitting watching TV in our old house, and as soon as the heating went off, I would feel the draft on my right shoulder, then my left shoulder would start to cool down..."

He describes his new house as incredibly ▶



(above) An airtight, insulated attic hatch which seals the hatch frame to greatly improve airtightness and thermal performance

comfortable. “There are just the two of us living here now, we’re in our late 60s and our family is grown up and moved out. Instead of trying to frugally manage warm rooms and cold rooms, which was the case in our old house, once we open our front door we’re in a really comfortable environment which is constant throughout the house. It’s 21C everywhere, so it’s a really, really nice place in which to live.”

Anne Mahon moved into her Bennett-built passive house in Grange Lough in Rosslare just over a year ago.

“The site is very windy, but because the temperature is so stable inside the house, I never know what kind of temperature it is outside until I go out,” she says. “I’d often think, oh it looks fine, I’ll go out, then I’d often have to come back and get a jacket.”

Like Ray McGahern, she found it impossible to heat her previous home, a 1940s era house in Terenure in Dublin. In Rosslare, the only radiators are in the bathrooms, and these are rarely used. Backup comes from a room-sealed stove in the living room. Mahon says she lights this mainly because she likes the look of the fire.

“If the house was in any way cool, like on a really cold day, you just leave the door of the sitting room open and the entire house is heated from it... and it’s so easy to adjust the amount of heat you get from it.”

The comfort levels are so good, says Ray McGahern, that he would happily pay a premium for running costs. In practise of course, the opposite is true.

“It runs on fresh air basically,” says Ann Mahon. “I can’t believe how low my bills are. I filled the gas tank when I moved in a year ago, and the gauge on it has hardly moved. I’ve only turned on the heat about three times, I just don’t need it.”

The design and build team estimate that the total annual cost for water and space heating in Madeira Oaks – to be provided by a Nilan Compact P, which combines an exhaust air heat pump and heat recovery unit to provide heating, cooling, ventilation and hot water – will come in at under €200. However, a photovoltaic array from Solar Electric Ireland on the roof of each house is expected to yield €200 worth of savings to electricity bills, effectively wiping out the Nilan unit’s parsimonious electricity costs for space and water heating.

It’s not only the calculated energy costs that are freakishly low at Madeira Oaks: measured noise levels are bound to be low too. Changes introduced to Part E of the Irish building regulations in 2014 mean that sound insulation levels must be measured at party walls between new homes, and must hit a target of 53 db or higher. The test at Madeira Oaks gave results of 66 and 69 decibels.

Interviewed for Passive House Plus editor Jeff Colley’s Green Living column in the Irish edition of the Sunday Times, sound tester Ted Dalton of Dalton Acoustics made sense of the numbers. “53db is a level at which you shouldn’t be able to hear people living in their home next door. But when you increase that by 10db, you make it twice as loud.”

While the tests indicate the houses will keep out well over twice the noise levels specified under the regulations, Dalton puts that performance in context.

“The higher result [of 69db] is akin to the kind of sound insulation we attempt to design into walls between commercial cinemas.” An experienced and prolific tester of housing, Dalton is clearly impressed with the result at Madeira Oaks. “I’ve never seen a result like this on a party wall,” he says, a performance level affected by the general quality of the building envelope.

Although the test measured noise at the party wall – which in this case may be very well soundproofed – Dalton says the exemplary results are also due to the quality ▶



(above, from top) Stages of the wall build-up showing Intello airtightness membrane, with services behind battens, and 50mm thick service void insulated with Isover Metac insulation provided to inner leaf prior to Gyproc plasterboard





of the building envelope. In normal buildings sound can escape via flanking pathways in building envelopes, literally going out through one window and in the other. “It’s like a leaky bucket,” he says. “It’ll find the path of least resistance.”

But this high level of performance was in large part due to the party wall spec. Cellulose insulation, which is used throughout the building’s walls and roof, is well-known for its acoustic properties. At the party wall this is followed by Coillte’s newly developed VapAirTight OSB, under Gyproc Plank – a 19mm version of Gyproc’s Wallboards, which itself boasts sound insulation benefits, followed by a layer of standard 12.5mm Gyproc Wallboard, with the joints of the two layers deliberately staggered to reduce sound transmission, and a sealant used at floor and ceiling level.

Bennett’s insurer, Creane & Creane Insurance in Enniscorthy, is offering home insurance free for the first year to the new owners. Bennett says that when he took the company MD, Tony Doyle, on a tour of the house, Doyle zeroed in on unlikely elements of the build.

“He wanted to look at the water works, the pipes and all of that. Both hot and cold water are lagged, inside and out. Our copper cylinder is not in the hotpress upstairs, it’s in the Nilan unit downstairs in the utility room, so it can’t leak down through the house. The water storage tank normally sits in the attic, but ours is outside... so it can’t burst and drain water down through the house. So the exposure an insurance company has to carry is significantly reduced – and that’s all down to how we designed it.”

Bennett provides a manual with every house sold. In addition to comprehensive information on how to operate everything in the house, it also contains contact details for everyone involved in the build. He’s keen to point out however that he used to do the same thing when he built non-passive housing. Living in a passive house isn’t really any different to living in a conventional house.

“They’re a home, they’re for living in, they’re not different really to any other house other than you haven’t those expenses, and the way the fabric is built, it’s a warm house, it’s comfortable living... anyone who lives in one will tell you that.”

Bennett admits that his profit margins on these houses are low. The €170,000 price was chosen in part to get the development launched, and in part to prove a point – that affordable passive is possible.

“I’ve always said that passive houses are affordable for everyone,” says Bennett. “We’re building them as cheap as traditional houses. There’s no premium any more. That’s gone.”

Cost comparison: Madeira Oaks versus a typical Dublin semi-D

If the prices of the homes at Madeira Oaks are impressively low, they’re even moreso when viewed in context.

Last September, the Society of Chartered Surveyors Ireland – the representative body for surveyors, including quantity surveyors – launched a report for government on the policy options available to enable the delivery of affordably priced housing in a market where demand is far outstripping supply.

The report cited an example of a typical three-bed Dublin house – as luck would have it, the same basic house type as the homes at Madeira Oaks, albeit coming in at a marginally larger 110 sqm. The total development cost, excluding land prices, but including all other costs –house construction, external works, site development costs, indirect costs, profit margin, fees, levies and taxes – added up to €256,000, based on 2014 prices.

More starkly, if the overall construction costs inclusive of VAT are added up (but not counting fees for an assigned certifier under the building control regulations, consultant design fees, marketing, finance, development levies and contributions, and VAT on each of these elements) the total comes to over €171,000 – more than the asking prices for certified passive houses with net zero heating and hot water bills at Madeira Oaks. ▶





(clockwise from top left) The Nilan Compact P combines an exhaust air heat pump and heat recovery unit to provide heating, cooling, ventilation and hot water; rooms are heated through vents in the floor; heating controls for the Nilan system; the distribution manifold gather the tubes with supply and extract air and carry the air to and from the ventilation unit

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(above) The water storage tank is situated outside, as opposed to the attic, so it can't burst and drain water down through the house

SELECTED PROJECT DETAILS:
Developer/main contractor: Michael Bennett & Sons
Architect/passive house consultant: MosArt
Civil / Structural engineer: Arthur Murphy & Co.
Airtightness tester/consultant: Greenbuild
Acoustic consultant: Dalton Acoustics
Mechanical contractor: Harry Ryan Plumbing
Electrical contractor: Doyle Bros.
Build system & cellulose insulation: Shoalwater Timberframe Ltd.
Mineral wool: Isover
Floor insulation: Xtratherm
Airtight membranes & tapes: Ecological Building Systems
Airtight OSB: SmartPly
Plasterboard: Gyproc
Windows and doors: Munster Joinery Ltd.
Heat pump & MVHR: Nilan Ireland Ltd.
Radiators: EEW Ltd.
Photovoltaic supplier: Solar Electric Ireland
Sanitaryware: DPL Ltd.
Roof tiles & concrete: Dan Morrissey & Co.
Insurance: Creane & Creane Insurance





(above) The party wall spec is a key factor in the excellent soundproofing performance. It features cellulose insulation behind Coillte's newly developed VapAirTight OSB, under Gyproc Plank, followed by a layer of Gyproc Wallboard, with the joints of the two layers deliberately staggered to reduce sound transmission, and a sealant used at floor and ceiling level

PROJECT OVERVIEW

Development type: 12 unit scheme, consisting of 102 square metre, 3-bed, semi-detached two-storey timber frame houses constructed to certified passive house standards.

Location: Madeira Oaks, The Moyne, Enniscorthy, Co Wexford.

Completion date: The first two houses (No. 177&178) will be completed end of March 2016.

Budget: Not disclosed. Selling price €170,000

Passive house certification: Pending.

Space heating demand (PHPP): 13.83 kWh/m^2/yr (provisional)

Heat load (PHPP): 9 W/m^2

Primary energy demand (PHPP): 112 kWh/m^2/yr

BER: Provisional BER Certificate of A2, Final Cert. awaited.

Airtightness (at 50 Pa): 0.44 & 0.42 ACH

Thermal bridging: All detailing of thermal bridging are in excess of ACDs.

Ground floor: Ground supported concrete slab, 230mm Xtratherm PIR insulation (laid in three layers of 100mm, 80mm, 50mm, to enable the 80mm ductwork from MVHR system to be encased in the floor). **U-value:** 0.086 W/m^2K

External walls: Factory-built timber frame with cavity and 100mm thick rendered blockwork rain screen for outer leaf, filled with 184mm cellulose, Intello airtightness membrane and 50mm thick service void insulated with Isover Metac insulation provided to inner leaf prior to plasterboard with skim finish Gyplite plaster. **U-value:** 0.179 W/m^2K

Roof: Concrete roof tiles on fabricated roof trusses. Intello membrane to the underside of the roof trusses, 50mm service void, and 12mm plasterboard with skim finish Gyplite plaster. Infill above airtightness layer with 500mm cellulose insulation, full filling around truss members etc. **U-value:** 0.081 W/m^2K

Windows: Munster Joinery Passiv Future Proof triple-glazed windows range, Passive House Institute certified. **Ug-values:** 0.55 W/m^2K. **Uf-values:** 0.76 to 0.84. Overall **U-values:** 0.84 W/m^2K

Heating/ventilation system: Nilan Compact P unit, Passive House Institute certified, combining mechanical heat recovery ventilation with hot water generation and storage, backed up with an additional 1 kW of secondary space heat generation. MVHR heat recovery efficiency at 80%.

Renewables: Solar photovoltaic array provided by Solar Electric Ireland with an expected output of between 750-1100kWh/a.

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The digital magazine is available to subscribers on www.passive.ie

Photos: Eustace Tierney

FERMANAGH SCHOOLHOUSE

reborn as passive family home





The abandoned husk of a 1960s school building sounds a very long way from a comfortable, ultra low energy family home. Thanks to a remarkable upgrade effort – influenced by reading Passive House Plus – one Fermanagh family are reaping the rewards of one such transformation.

Words: John Hearne

Gerry McPhillips made it clear from the outset that his new home wasn't merely going to meet Enerphit, the Passive House Institute's standard for retrofitted buildings. It was going to be certified that it met the standard.

This was a particularly ambitious aim for several reasons. For one thing, the building into which he planned to move his family once the job was complete wasn't even a house. It was a disused school. Achieving passive standards on a new build is tricky enough. Retrofitting passive into an old one is even trickier.

When you also factor in the lack of any passive building experience on his design and build team, the fact that this is Northern Ireland's first Enerphit project is even more creditable.

"You can't call it a passive house unless it's certified," says McPhillips, explaining his thinking, "but that isn't the biggest reason I went for it. Probably the main thing – and this was mentioned in lots of the blogs and articles I read – is that it keeps people honest."

He points out that if you make it clear that the house will be certified, the targets solidify. An airtightness result of below 1 ACH at 50 Pascals is not a nice-to-have. It must be that airtight in order to achieve certification.

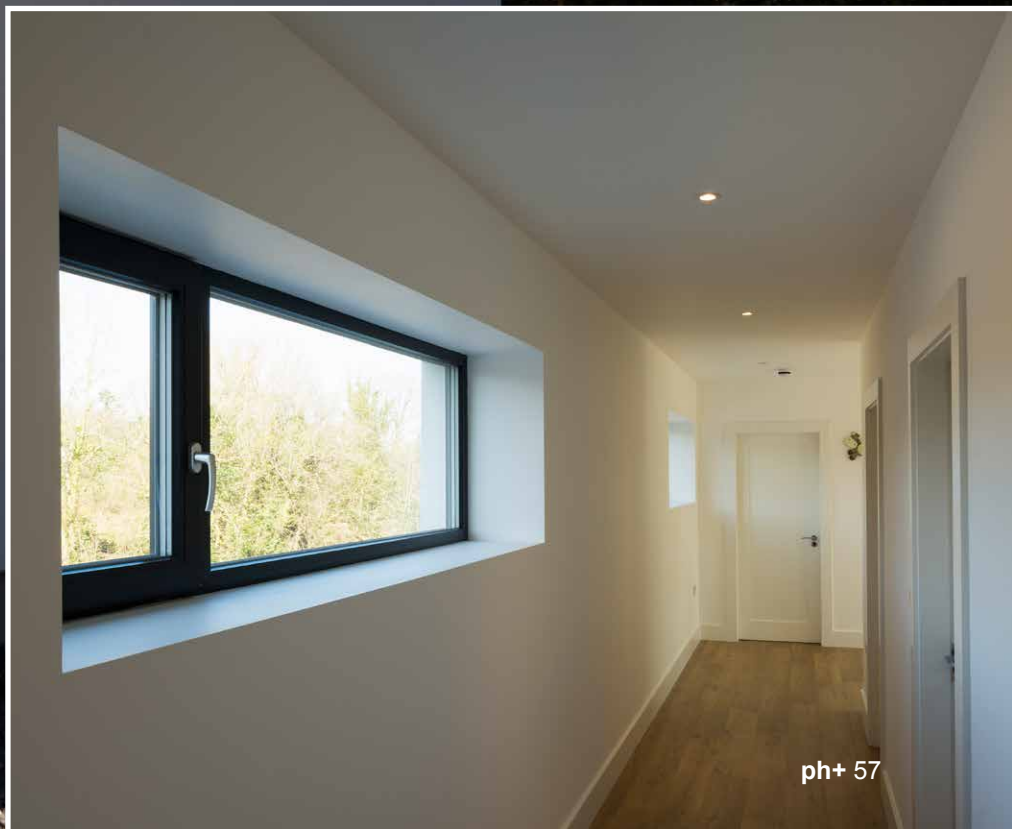
"When we tell the project manager that at the start, he knows what he's aiming for. He takes on the responsibility to meet that target... Otherwise, you get the 'ah sure it'll be grand approach'. That was the main reason for saying yes, it is getting certified, it has to meet this standard."

McPhillips had originally planned to build a house on his father's land at Magheraveely in Co. Fermanagh. Planning restrictions however required that any new structure be 'visually linked' to the existing farm buildings, which essentially meant placing the house at the centre of a working farm.

This wasn't going to work for the family, so they began looking further afield. It was McPhillips' father who suggested looking more closely at his old primary school when it came up for sale in 2014. It had been closed down two years earlier as part of a rationalisation process that closed several other small schools in the area.

This was a typical 60s schoolhouse. An elongated, single-storey with huge south facing windows and extensive grounds. The one big advantage of the building was its location. It stood right at the end of the lane that led up to his parents' farm.

"We knew before we bought it that the Planning Service wouldn't look kindly on an application for demolishing an existing building in order to build a new one," says McPhillips. "Essentially, they said we had to retain as much of the building as we could. That was our starting point." ▶



There was a certain amount of flexibility however. The school itself was beginning to slip into disrepair and the grounds had become overgrown. Aware of the need to create a family home from an old school, the Planning Service allowed McPhillips to strip the building right down, remove the roof and raise the walls.

The drive for passive emerged early in the project. As McPhillips worked through his research, searching for a way to keep running costs down, he found that he was consistently being drawn back towards low energy in general, and passive in particular.

“Passive House just kept coming up as the way to do it. It was a tested approach, one that had been around for twenty years or more. Everyone I talked to, and everything I read – including Passive House Plus magazine – encouraged you to believe that it could be done. The other thing in its favour was the fact that people in Ireland were doing it. It wasn’t just happening in Germany, there were plenty of examples and they weren’t that far away.”

At the time however, most of the passive projects either completed or underway were south of the border. There was a general lack of expertise in Northern Ireland.

Things were however changing in that regard. McPhillips had discussed other possible sites and projects with Enniskillen-based architect Chris Allen before he settled on the school in Magheraveely. When he returned to Allen to discuss his plans, Allen told him that he had already signed up with the Passive House Academy’s certified passive house consultant & designer course in Wicklow.

The architect explains that this job was very different to any he’d worked on before. “Building regs in the north,” he says, “while they’ve improved in terms of what they require, as regards thermal properties, they’re very straightforward, very simple. The Enerphit approach looks at every aspect and is quite detailed in every aspect, so it was a major change, certainly.”

Together, Allen and McPhillips decided to remove the roof in order to create more height in the building. In addition to giving sufficient room to incorporate a second storey, constructing a new roof made achieving airtightness considerably easier by allowing the build team to incorporate airtightness measures into the new design.

Probably the greatest single challenge however lay in tackling the thermal bridges. To help here, McPhillips sought advice from the Centre for Renewable Energy and Sustainable Technologies (CREST), which is attached to South West College in Enniskillen. The centre – housed itself in a passive house pavilion designed by Paul McAlister Architects, which was the subject of a case study in issue 11 of Passive House Plus – supports innovative renewable energy and sustainable technology initiatives in Northern Ireland, and is partially funded by the European Union.

Barry McCarron of CREST explains that the centre supported the project by providing advice on the two critical passive areas of airtightness and thermal bridging.

“We carried out some analysis on thermal ▶





“Good indoor air quality can minimise the symptoms of asthma, which our eldest daughter suffers from. Since we’ve moved in, her symptoms are definitely not as bad.”





bridging and made some suggestions which were incorporated into the building," he explains. Quinn Lite aerated blocks were set into the inner leaf at critical points, while ply boxes were specified for window reveals.

As frequently happens with passive retrofits however, some puzzles just could not be solved.

"There was a huge thermal bridge that couldn't be dealt with," says McCarron. "It was a 17m internal wall, and we just had to take the hit on it. That happens, it's just part of Enerphit, and it's reflected in how the matrix of passive house is relaxed for it."

In order to boost the team's airtightness expertise, McPhillips and his project manager, Clive Morrow completed a one-day airtightness course with Ecological Building Systems in Athboy, Co. Meath.

"Airtightness was one of the biggest challenges," says McPhillips, "because it was new for everyone on site."

Gerry's brother, Stephen – a carpenter by trade – completed most of the airtightness work. In addition, both their father and Gerry's father in law – both retired builders – pitched in on site with help and advice.

The final airtightness test recorded a result of 0.77 ACH at 50 Pascals – well within the Enerphit threshold.

Barry McCarron of CREST says that having a highly motivated design team more than made up for the lack of passive experience on site. "Chris was a very progressive architect, he was switched onto everything and he was very willing to work with us in solving any issues that arose... and Gerry was very keen to pursue the passive house thing. There would have been moments where cost decisions were being thrown about. His willingness to go all the way to get passive made those decisions easier."

The existing narrow cavity wall had been pumped by the educational authority not long before the school had been closed, but even at that, it didn't get close to the standard required by Enerphit. The design team decided to supplement existing insulation measures with external wall insulation. In addition to solving thermal issues, Chris Allen says that it also solved aesthetic ones.

"Because we were increasing the height of the building and we were closing in openings, the blockwork naturally looked patchy. If you used an ordinary render, you'd still tend to see where there was new blockwork underneath – that sort of patchiness – but because of the external insulation, we didn't have that issue."

The floor was insulated with 200mm of Ballytherm PIR insulation beneath a 75mm screed, while 400mm of Isover Metac insulation was installed in the roof on the flat.

Prior to the move, the family had been staying in a series of rented houses, which tended to be old and damp. They moved into their new home in August, and so far, so good – including some unforeseen benefits.

"The house is really quiet inside, we hear very little outside noise," says McPhillips. "There were a couple of occasions recently where neighbours were woken up because of a dog barking most of the night, but we hadn't heard a thing."

The family has also been feeling the benefits of a ventilation approach that delivers a constant supply of filtered fresh air. "We were aware that having a good ventilation system can really help people with respiratory problems," says McPhillips. "Having good indoor air quality can minimise the symptoms of asthma, which our eldest daughter suffers from. That was certainly one of the things that I was keenly aware of. And since we've moved in, her symptoms are definitely not as bad as before."

"It's very comfortable, very warm and is performing as designed. It's been great, we're very happy with it." ▶





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(clockwise from bottom) Strategically placed Quinn Lite blocks to reduce thermal bridging at the gable wall and window and door opes; the school building being partially deconstructed, extended upwards, wrapped in external insulation and rendered

SELECTED PROJECT DETAILS:
Clients: Gerry & Melissa McPhillips
Architects: Chris Allen Architects
Project manager:
Clive Morrow CM Management
Airtightness & roof insulation contractor: Stephen McPhillips Joinery
Passive house consultant: Chris Allen Architects / CREST – Barry McCarron
Airtightness testing: Air Seal Ltd.
Energy rating assessment:
Energy Control Ireland
Electrical: WJF Electrical
Plumbing: D&M Plumbing and Heating
Airtightness products:
Ecological Building Systems
External insulation:
Clarke Eco Wall/Kingspan
Floor insulation: Ballytherm
Roof insulation: Isover
Thermal breaks: Quinn Lite
Windows & doors: Rehau, via True Windows
Heat recovery ventilation:
Duplexvent, via BPC Ventilation Ltd.
Heat pump: Thermia, via Warmth Ltd.

PROJECT OVERVIEW

Building type: A 286 sqm rural 1960s Irish primary school refurbished with a second-storey extension

Location: Cornagague Primary School, Magheraveely, Co. Fermanagh

Budget: Not disclosed

Enerphit certification: Pending with the Passive House Academy

SPACE HEATING DEMAND:
Before: Not available (no energy calculations done on original building).
After: 18 kWh/m²/yr

HEAT LOAD
After: 12 W/m²

PRIMARY ENERGY DEMAND (PHPP)
After: 117 kWh/m²/yr

ENERGY PERFORMANCE CERTIFICATE (EPC)
After: B89 & CO_2 Rating B90

AIRTIGHTNESS (AT 50 PASCALS)
After: 0.77 air changes per hour

FLOORS
Before: Standard concrete floor build up. **U-value:** 0.61 W/m²K.
After: 200mm Ballytherm PIR insulation under new 75mm concrete floor screed.
U-value: 0.10 W/m²K

WALLS
Before: Concrete block walls with 65mm fully filled cavity with blown bead insulation. **U-value:** 0.38 W/m²K.
After: Original insulated cavity wall retained followed externally by 150mm Kingspan Platinum EPS insulation and K-Rend render finish.
U-value: 0.13 W/m²K

ROOF
Before: 200mm fibreglass wool insulation on the flat between roof joists.
U-value: 0.20 W/m²K.
After: 400mm Isover mineral wool insulation on the flat between roof joists.
U-value: 0.11 W/m²K

WINDOWS & DOORS
Before: Double-glazed, PVC windows and doors. Overall approximate
U-value: 1.7 W/m²k - 1.3 W/m²k.
New triple-glazed windows: Rehau Geneo MD plus triple-glazed windows and doors: Overall U-value of 0.76 W/m²K.

HEATING SYSTEM
Before: Oil fired central heating with standard efficiency boiler.
After: Thermia Diplomat Optimum Duo 10kW ground source heat pump with COP of 4.24 as per EN 14511. Underfloor heating system to downstairs. Towel radiators in bathrooms.

VENTILATION
Before: No ventilation system. Reliant on infiltration, chimney and opening of windows for air changes.
After: Duplexvent DV145SE heat recovery ventilation system — Passive House Institute certified to have heat recovery rate of 79% / EN 308 certified efficiency of 90%+.



1960s 'icebox' transformed into

WARM & BRIGHT ECO HOME

A deep retrofit of this 1960s block-built home turned it into a modern ultra low-energy home that emphasises wood, light and natural materials.

Words: Kate de Selincourt

In the 1960s, UK Prime Minister Harold Wilson urged the nation to embrace the "white heat of scientific revolution". House designs may have made a superficial nod to modernity, but the scientific revolution did not bring much building physics into the domestic sphere. As those of us who grew up in them can testify, the houses of the time were often freezing.

When Martin and Brigitte Sims decided to move out of central London, the house they bought was no exception. A typical 60s detached house, it had been improved little since its construction. Some of the windows had been double-glazed and some of the cavity walls had been insulated, but others had not been touched. None of these measures had made a lot of difference; the house was still, "an absolute icebox".

However the couple were prepared for this — as a German-trained energy assessor, Brigitte Sims knew that pretty much any house they bought in the UK would be in need of radical retrofit to make it comfortable and energy efficient.

While the house was cold and unappealing, it had everything else the Sims were looking for: a wonderful garden of 1.6 acres, including an acre of unmanaged woodland – enough to produce enough wood to be self-sufficient in heating fuel – and still ample space for growing their own fruit and vegetables. The roof faced due south, ideal for photovoltaic generation, and the house was structurally sound enough to take an extensive retrofit.

Martin and Brigitte contacted Paul Mallion of Conker Conservation to help them transform the house. Paul drew up plans for a comprehensive retrofit, to include much improved airtightness and ventilation, external insulation, and all new doors and ▶

windows (including new openings to increase solar gain, daylight, and views to the garden).

The project also included converting a garage into an accessible annexe for parents, and building an extension above to add a bedroom. The south-facing living room was also extended, creating a sunspace at the front.

Energy efficiency targets

A limited budget and a preference to not use MVHR ruled out aiming for the passive house or Enerphit standards, but Paul Mallion suggested the AECB Silver Standard instead. Paul calculated the space heat demand of the unimproved house to be an alarming 205 kWh/m^2/yr, and his calculations predicted they would achieve just 36 kWh/m^2/yr for the retrofitted, extended house – well within the AECB Silver Standard target of 40kWh/m^2/yr.

The structure of the house is of masonry cavity wall construction – with cross-walls at each gable — and the front and back walls were also of masonry cavity with decorative finishes such as tile-hanging, which had prevented cavity fill on those faces.

Cavity wall buildings can be complicated to make airtight — there are more hidden gaps, and the inner leaf may not have been constructed that carefully, as it is out of sight, and not needed for weather-tightness.

An initial air test by Paul Jennings (then of Aldas) showed a "typically poor" result of 11.25 air changes per hour at 50 Pascals – effectively 19 times the leakage rate of a passive house. A final airtightness target of 3.0 ach was set: "With cavity construction there are always places you can't get at without taking walls down — holes effectively built into the fabric — so we use a fairly conservative target in the PHPP calculations," Paul Mallion says, "you have to be realistic."

Paul Jennings was able to identify many of the main leakage points that would have to be tackled, including leakage through electrical back boxes, wall-to-floor junctions and wall-to-ceiling junctions.

The main airtightness strategies were internal parging, including re-plastering over taped cavity closures, and membranes and taping in the timber stud extension. A particular challenge was posed by the fact that the existing double garage was to be bisected, with one half remaining external to the airtightness and thermal boundaries, and the inner half wrapped into the thermal envelope to form the annexe.

Thermal strategy

As with most retrofits, a number of balancing acts were needed when arriving at the final design for heat loss, juggling ultimate performance against the expense of installing a measure or reconstructing the fabric, within a fixed budget. As Paul Mallion explains, PHPP really came into its own when assessing options.

"Analysis showed that while there would have been a very significant benefit from replacing the uninsulated concrete floor, this would have been prohibitively expensive. However there was space to add between 50 and 75mm of polyurethane insulation board, and the analysis also showed this gave an acceptable result," he says.

"The clients were pragmatic and clear about when to draw the line, how far to pull the house apart to achieve certain standard. They were also quick to make decisions, which really helped."

The main insulation strategy for the walls was external wood fibre insulation – using Steico Protect – finished with lime render and weatherboarding. The part-filled and unfilled cavities were also topped up with mineral wool.

The clients' preference for natural materials meant they were happy with Paul Mallion's preference for wood fibre insulation — he has a lot of experience with it from conservation work on historic buildings. "Wood fibre is beautiful to work with, and easy to install once you get the hang of not bashing the corners; it locks together," he says.

The roof was in good condition but the roof ventilation was upgraded, the existing loft insulation completely removed, and 300mm of Warmcel laid with an extra layer of cross laid 100mm Thermafleece sheeps wool on top.

Thermal bridges (such as the cast concrete lintels that spanned the cavity walls front and back) were mostly dealt with by using the external insulation, but many complex junctions were involved in the conversion of the garage and abutment of flat roofs, requiring careful positioning of both internal and external insulation.

Because the roof was not in need of replacement, it was not cost-effective to take it apart to get a full thickness of insulation right over the top of the walls. Instead, the internal eaves were treated with an insulated cornice, in order to minimise cold bridging.

Ventilation

Paul Mallion was able to show in PHPP that the installation of MVHR could have reduced space heat demand by half, "but I could not persuade the clients. One reason was simply the cost, but they had also read about MVHR going wrong, and were concerned it would be noisy."

Instead, the clients opted for decentralised MEV (mechanical extract ventilation) units which have a declared noise level of just 10 dB. To make sure they could live with them, the clients even purchased a fan before installation, to run overnight in their bedroom.

Despite the energy cost of missing out on heat recovery, Paul Mallion believes the dMEV was a good solution. "With dMEV, no ductwork is needed. The extract fans are located in each wet room and run constantly at a very low speed, drawing air from habitable rooms." Trickle vents were placed in some windows, and through-the-wall ventilators in some rooms. "With hindsight, retrofitting ductwork for MVHR would have been very hard," he adds.

Glazing strategy

As well as adding full-height south-facing windows to the living room, it was decided to add new clerestory bedroom windows, and new glazed doors to the west side of the dining room. PHPP analysis suggested there was a risk of overheating for 2% of the year.

Because money was tight, the clients decided not to add extra shading beyond the flat roof overhang at the living room. However, given the potential risk, structural timbers were included above the south windows, able to support a shade or brise soleil, which the clients now intend to install.

"The house doesn't overheat often — but when it does, it gets very hot!" Brigitte Sims ▶







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(above) In winter, if the water tank is hot and there is still surplus generation, power is sent to a set of 'heat mats' – electric heaters set behind ceramic tile emitters in the floor and walls of the northerly rooms in the house

explains. "But thanks to Paul's calculations we are prepared, so adding shading will not cost much extra".

Heating, services, renewables

The use of renewable energy was an important aim of the clients, who wanted to live more sustainably, cut their energy bills, and generate their own energy rather than use fossil fuels.

The main heat source is a 4-8kW Haas & Sohn wood stove. Over the year it provides an estimated 75% of the space heat. The downstairs is open plan, with double doors to the hall and stairs allowing heat up to the first floor.

Martin Sims is delighted with how well it works. "The stove is excellent: in winter it is our only source of heating. The stove has a heat sink surround made from 200kg of sandstone, which means it holds the heat much longer. If it's fully fired up, the stones radiate heat well for up to 6 hours, and are warm to the touch for ten."

A 3.6kWp photovoltaic array contributes electricity for daytime use (including appliances and home working), and some of the PV generation is also stored as heat.

A 170 litre thermal store contains a dedicated immersion heater controlled by an Immersun switching control, which ensures that whenever the solar panels are generating more than is being used in the house, PV power is used to heat the water. A second immersion heater, on a timer, tops up the tank using off-peak electricity when required.

The Immersun operates a 'daisy chain' cascade of switching, so in winter, if the water tank is hot and there is still surplus generation, power is sent to a set of 'heat mats' – electric heaters set behind ceramic tile emitters in the floor and walls of the northerly rooms in the house, including the annexe.

"The heated panels are a lovely comfortable feature", says Brigitte Sims. "People are really drawn to their gentle heat; visitors are always saying 'I want one of these'."

Without detailed monitoring the Sims are not sure how much power goes where, but since a faulty unit was replaced nine months ago, the Immersun has diverted over 500kWh of PV power. The Sims are fairly low hot water users (<100kWh/month), which suggests perhaps half the hot water is solar-heated, depending how much is also passed on to the heating panels.

Lighting is mostly by LEDs, and the kitchen has an induction hob. To retain gas it would have been necessary to re-route the gas main, which would have cost as much as their chosen heating system, so the Sims were happy to disconnect it instead.

Maintaining standards on site

To achieve the standards of comfort and energy efficiency the Sims were looking for, considerable attention to detail was needed during construction. Because neither Paul Mallion nor the clients were close enough to attend site regularly, this proved a bit of a headache initially, with some details being missed. However, the solution came in the form of experienced passive house builder Antoine Constantini of Kithurst Builders, who was brought on to the team to guide the site crew on a weekly basis.

This worked well — for example, the airtightness target was met and exceeded, with a final test result of 2.5 air changes per hour at 50 Pascals. But more to the point, the Sims have the house they wanted — warm, bright, comfortable, and they say, giving occupants and visitors alike a real sense of wellbeing.

The house is attractive on the outside, without looking out of place among its unclad neighbours. The original spirit of the design is maintained, but where there were shabby tiles and dingy bricks, there is now crisp fresh render, and clean blocks of coloured weatherboarding.

With a lot of natural light and natural materials, the interior is designed to be healthy, with minimal plastics and synthetic chemicals. The clients are very pleased with the performance of the ventilation, too. "It was so valuable having Paul make the air flow calculations, so we could ensure the right level of ventilation without any draughts," Brigitte Sims comments.

As well as showing their interested neighbours around the house, the Sims are also sharing their experiences more widely, and have hosted visits from several local Transition Towns organisations.

"We found it really hard to get good information about this kind of retrofit when we started out," Brigitte Sims recalls. "We think it's really important to share our experience, to inspire other people about what can be achieved." ►







(from top) While scope for invasive airtightness work was limited on the existing building, the extension offered the opportunity to get the detail right; the main insulation strategy for the walls was external insulation, with treated XPS below DPC and Steico Protect wood fibre insulation above, finished with lime render and weatherboarding

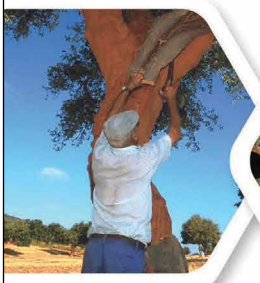
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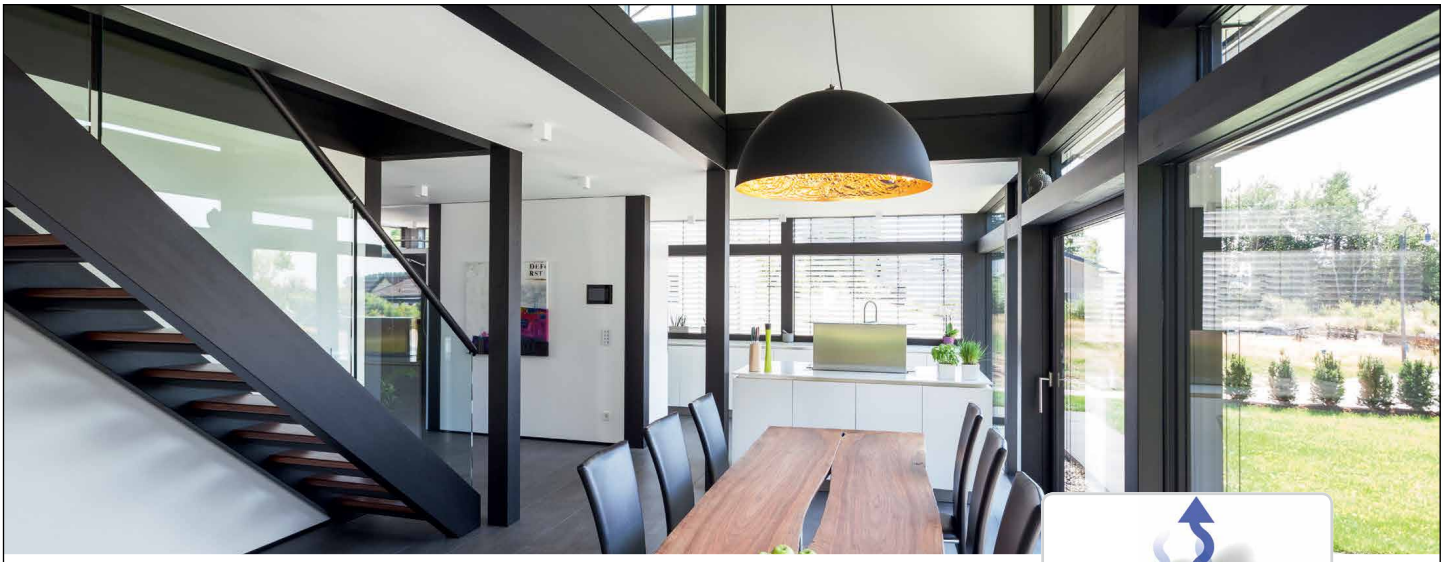
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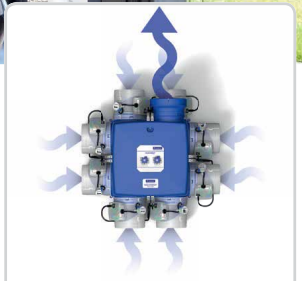
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Loft hatch: Fakro
Airtightness products: pro clima
Windows & doors: Katzbeck
Wood burning stove: Haas & Sohn
Solar powered electrical wall panels: Thermogroup
Solar PV: Solasave
Solar PV controller (Immersun): 4Eco Ltd
Eco friendly paints: Osmo, Dulux
MEV fans: Vent Axia

PROJECT OVERVIEW

Building type: Detached 1960s four-bedroom house, crosswall construction consisting of cavity walls at each flank and tile-hung brick/block cavity walls to front and rear. Solid ground floor and attached garage/utility room in solid brick construction. House extended over garage to form additional bedroom and ensuite, garage converted into accessible annexe, and living room extended forwards to the south to create sun-space under a flat roof. Treated floor area as existing 97 square metres.

Location: Semi-rural cul-de-sac on the Hampshire / Surrey border, UK. Bespoke weather data obtained from BRE for site, due to distance from standard weather stations and local conditions – an unusually exposed location.

Budget: £65,000 approximately

SPACE HEATING DEMAND
Before: 205 kWh/m²/yr **After:** 36 kWh/m²/yr

HEAT LOAD
Before: 72 W/m² **After:** 18 W/m²

PRIMARY ENERGY
Before: 403 kWh/m²/yr **After:** 116 kWh/m²/yr
Environmental assessment method: AECB Silver Standard certified

MEASURED ENERGY CONSUMPTION
Total electricity consumption from November 2014 to November 2015: 1,444 units. Wood fuel consumption from November 2014 to 2015: 1.1 tons (estimated 4,400kW)

AIRTIGHTNESS
Before: 11.25 air changes per hour (9.88m³/m²hr) **After:** 2.5 air changes per hour (2.1m3/m2hr) (target was 3.0 ach)

WALLS
Before: Crosswalls consist of brick/brick cavity walls, 50mm glass fibre injection. **U-value:** 0.563 W/m²K. Front and rear walls of uninsulated cavity brick/lightweight blockwork with tile hanging. **U-value:** 1.549 W/m²K. Garage/utility walls, solid brick. **U-value:** 2.107 W/m²K
After: Crosswalls upgraded externally with 100mm Steico Protect wood fibre boards under lime render. **U-value:** 0.247 W/m²K
Front and rear walls, tile hanging removed revealing in-situ cast concrete boot lintols which would be costly to remove. Walls upgraded with 100mm Steico Protect wood fibre boards under timber painted weatherboarding. **U-value:** 0.249 W/m²K. Garage/utlity walls, upgraded with 89 x 45mm studs with Steico Flex between, 100mm Steico Protect wood fibre board under lime render. **U-value:** 0.169 W/m²K
Walls below DPC level insulated with 100mm extruded polystyrene and painted with bitumen, to reduce cold bridge at floor perimeter and compensate for relatively poor floor U-values. At eaves junction internally an insulated cornice formed to reduce thermal bridge.

ROOF
Before: 225 x 50mm joists boarded and felted. **U-value:** 1.692 W/m²K.
After: New flat roofs to utility area and sunspace extension formed from 200 x 50mm SW, insulated between using 2 layers of 100mm Steico Flex wood fibre, WBP plywood deck and 80mm PUR insulation forming part of mineral felt built up roof system with VCL laid over plywood. Underlined internally with vapour control layer and plasterboard. **U-value:** 0.131 W/m²K

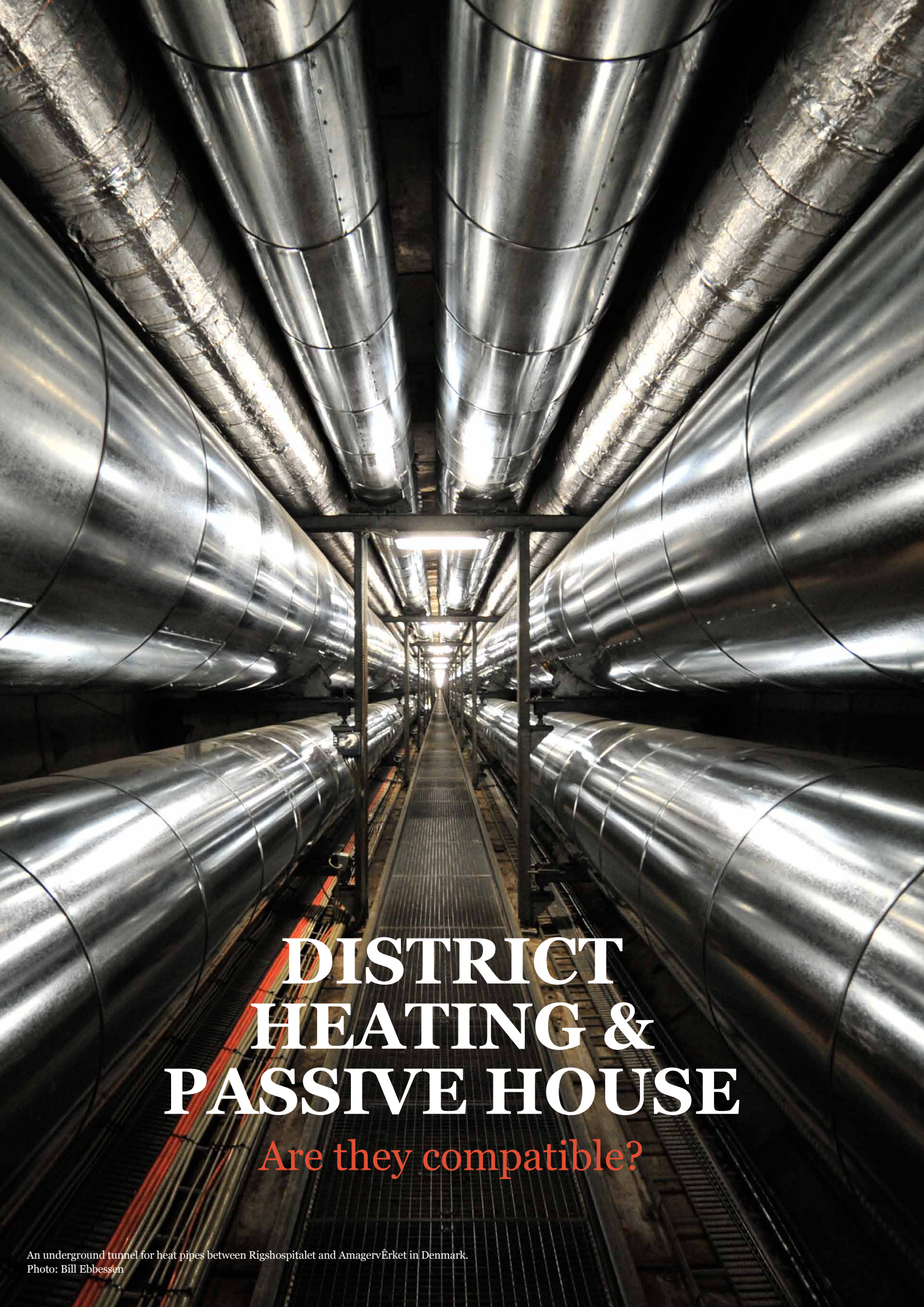
FLOORS
Before: Concrete slab with screed and woodblock flooring.
U-value: 2.166 W/m²K. **After:** Wood blocks and screed lifted, revealing differing slab levels beneath. 50 to 75mm PUR laid over levelling screed, covered with 18mm low formaldehyde chipboard and lino sheet. **U-values:** 0.42 to 0.303 W/m²K

WINDOWS & DOORS
Before: Single-glazed, timber windows and doors, overall approximate **U-value:** 5.8 W/m²K, and low quality double-glazed PVCu, **U-value:** 2.7 W/m²K. **After:** Katzbeck Fenster triple-glazed tilt and turn timber alu-clad windows and doors. Ug value 0.60, g value 0.50, Average U-value across all windows and doors 1.0 W/m²K. Fakro airtight insulated loft hatch.

HEATING
Before: Originally gas fired warm air ducted heating system, replaced in 1970s with gas boiler and limited number of radiators. **After:** Wood stove with direct external air feed. Electric wall mats and underfloor mat covered with ceramic tiles fed by solar PV. Direct electric hot water cylinder with efficient heat exchanger, and two immersion heaters, one connected to grid and one connected to the Immersun controller to prioritise solar PV to hot water and heating before exporting any surplus.

VENTILATION
Before: Original warm air heating system ducts for recirculation of air. No formal ventilation system. Reliant on infiltration, chimney and opening of windows for air changes.
After: Mechanical extract ventilation system using trickle vents in some windows, wall vent in living room, and Vent Axia decentralised MEV fans in wet rooms. Internal window formed between annexe and stairwell to improve air/heat circulation.

Electricity: 14 panel Panasonic FIT/hybrid 3.4 kW solar photovoltaic system.
Green materials: Steico wood fibre insulation used for external wall insulation system, directly rendered using breathable Lime Green render system. Flexible wood fibre insulation used between timbers in walls and roofs. Sheeps wool insulation used in loft. No tantalised timber allowed inside of the vapour control layer due to risk of off-gassing. Environmentally friendly paints also used.



DISTRICT HEATING & PASSIVE HOUSE

Are they compatible?

An underground tunnel for heat pipes between Rigshospitalet and AmagervÊrket in Denmark.
Photo: Bill Ebbesen

Thanks to fabric-first energy performance approaches such as passive house, heating demand is collapsing. So how does district heating stack up in buildings which need such little heat?

Words: Kate de Selincourt

As residential passive house in the UK and Ireland is moving up in scale from small developments to major projects involving hundreds of dwellings, communal heating in passive house is now on the agenda.

Communal heating (piped hot water supplying heat to all the occupants of a development) is common in large blocks of flats: individual gas supplies are subject to complicated safety measures in tall buildings; direct electric heating is the alternative, but is considered expensive and high-carbon.

In recent years the desire to use low carbon energy sources such as large heat pumps, combined heat and power, and biomass has also driven interest in district heating – district heating here being the supply of heat from outside the building.

There is a common view that networked heat is "more energy efficient, delivers carbon savings, and can reduce consumer bills."[1] Networked heat is therefore seen as having an important role in future decarbonisation. Cities, with their high density of heat consumers, are the most efficient market for heat, offering the highest ratio of heat sold to heat lost through distribution.

Some planning authorities now require new developments to be 'district heating ready' – even if there is not as yet a local supply of low carbon heat. The Mayor of London has "committed to generating 25% of London's energy requirements" through the use of local, decentralised energy by 2025.[2] In Ireland, too, district heating, particularly when fired by biomass, is promoted as "low carbon".

Energy efficiency, reduced emissions and low bills are exactly the aims of low energy building – so you might think that networked heat would be a natural partner with passive house. However, the two approaches can sometimes work against each other in practice, and there are also theoretical reasons why the two approaches might not be a good match.

Is district heating efficient?

Heat sources for a single-building communal system may be a plant room containing a conventional boiler, or a heat pump — plant efficiencies should be similar to individual sources. For a wider district heating system, a variety of technologies may be employed, for example gas powered CHP, biomass, "energy from waste" (burning garbage) and occasionally, industrial waste heat or geothermal energy.

The idea is that supplying a heat network from these large-scale sources will be more efficient and hopefully lower carbon, than individual or single-building heat generation. Unfortunately, evidence to date in the UK suggests the opposite. Inefficient distribution, and/or plant that fails to perform as intended, has resulted in schemes that are not efficient or low carbon at all.

In some case studies recently collated by Innovate UK in the Building Data Exchange (buildingdataexchange.org.uk), monitored losses in district and communal heating systems equalled or exceeded 50% of all heat supplied. In one development, "the overall system efficiency stood at 40% and 46% for two successive years. Assuming the boilers performed at the quoted 90% efficiency, system losses will have accounted for 45-50% of all the energy consumed."

Unfortunately this is not unusual. In an article on billing for district heating, Yan Evans of communal heating firm Switch2 wrote: "From our own experience and involvement in a significant number of community heating systems, including operating schemes as the ESCo, the overall efficiency of the heating system (fuel input through to delivered heat at the point of consumption) is typically between 50% and 60% once heat distribution losses have been taken into consideration."

Oversizing

When designing a communal heating system, engineers have to estimate the maximum amount of heat that might be required at any one time – and system design tends to be driven by a fear of missing this target, as Gareth Jones of Fairheat explains.

"M&E designers take a conservative approach," Jones says, and adds that professional indemnity insurance is one of the biggest drivers of this: "As one person put it, 'no one ever got sued for delivering too much heat'."[3]

Interestingly however, a Which? survey of customers of over 20 different district heating schemes found that too much heat was the most common complaint about system performance.[4]

One social tenant observed: "The corridors in our building are unbearable in the summer. We complained about the pipes being hot even though the radiators aren't on — it's dangerous" and another: "The pipes are so hot [that] I leave the windows open, even when the radiators are off."

In fact, traditional standards for calculating peak load overestimate what's needed, even before you start adding extra to be on the safe side, as passive house building services engineer Alan Clarke points out: "The old UK BS 6700 (now obsolete but still sometimes used) is completely wrong and leads to massive oversizing. Current good practice is the Danish standard,[5] but Danish researchers have looked at a range of standards and concluded they all over-estimate demand."[6]

Oversizing leads to plant that is too big and too expensive — and ironically, less efficient, as many heat sources work a lot better under full than partial load. Pipes will be too large, and flow temperatures may be higher than needed, all of which serves to exacerbate heat loss.

It probably hasn't helped that for domestic systems there has been no incentive in SAP to design networks to minimise losses. Pipe length and flow temperatures are not taken into account; instead SAP offers a blanket default external distribution efficiency of 95%. Thus designers receive no feedback to show if a design is an efficient one, and no penalty if it isn't. In one development evaluated by Innovate, recorded losses "were… eight times those assumed in the as-built SAP calculations".

Passive house wants even less

Because the fabric of a passive house is so well-insulated, much of the space heat can be supplied by existing heat sources — occupants, their day-to-day activities, and sunlight. This way, a lot of energy is saved. The corollary of this is that if too much heat gets into the building, it will not simply leak out, but needs to be removed, to prevent conditions getting too hot. Passive house designers therefore take care not to let too much heat into the building when it is not wanted — by adding summer shading, for example, and by ensuring hot water systems are well insulated.

Because district heating customers expect heat and hot water as instantaneously as if they had their own boiler, communal heating systems usually circulate hot water continuously. But continuous heat means continuous heat loss throughout the system.

Few studies of existing systems have given information about whether the losses occurred inside or outside the building envelope. Losses within the buildings do not necessarily appear in calculations and models at all, because in winter they contribute to heating the building so are not necessarily seen as losses. But the complaints referenced above suggest that there certainly is an excessive heat loss within some communally heated buildings; and if it is too much in a conventional building, it would be disastrous in a passive house.

The authors of one of the Innovate studies made a rough estimate that the internal distribution losses in the study buildings might equate to around 300W unmetered extra heat per apartment in the winter, and 150W unwanted extra heat per apartment in the summer. These apartments were low energy but not passive house; as passive house designer and certifier Peter Warm observes, what a traditional engineer might dismiss as a few hundred watts "is enough to cook a passive house."

Poor installation has clearly played a part in these poor efficiency figures, including into the buildings. In one of the Innovate case studies "the primary pipework [within the building] was insulated, but there were gaps at the back of the pipe… the valves and pipe connections were un-insulated due to the smallness of the gap between the wall and pipework, determined by the dimensions of pipe clips."[7] In another, so many valves and junctions were left uninsulated in the plant room its temperature was a stifling 35C.[8] ▶

Photos: Sustainable Projects Ireland





New Code of Practice

In light of the poor performance of district heating in the UK, CIBSE and the ADE (Association for Decentralised Energy) have published a new voluntary code of practice for district heating.

Gareth Jones has already found the guidance helpful when working to improve potentially inefficient designs, because it frames efficient design as best practice, which counterbalances the tendency to oversize.

Crucially, the code calls for distribution losses to be calculated (not just taken from SAP). It suggests that networks should design for system losses of no more than 10% in the sections of the network outside the building.[9] It also encourages designers to consider the risk of overheating: "With appropriate design the heat loss within the building should be less than 15%". However, questions remain about how the code, which is voluntary, could be enforced.[10]

Will it work in passive house?

As we saw, losses from internal distribution are not ignored by building occupants – and they can't be ignored in a passive house either. If communal heating is going to work in passive buildings, there needs to be a step change in both design and installation.

Can it be done? We'll soon find out, as the first UK passive houses with communal heating are now emerging.

Peter Warm has been involved with more than one of them. His overriding advice is: "If you have to do communal heating, absolutely the most important thing is to minimise the length of pipework." This is the approach being planned for the development of 350 passive house dwellings in high and mid-rise blocks at Agar Grove in Camden, north London. As Bertie Dixon of building services consultancy Max Fordham explains[11], their design strategy has vertical pipe risers straight through stacked flats, which allows for much shorter pipe runs than the more standard horizontal approach.

Losses also depend on the temperature in the pipes. At a standard 80/70C flow and return, losses will be around double those in an identical system run at 55/35C. However in the UK even 70/40C is seen as low temperature – even though Scandinavian systems dropped below this 40 years ago.

4G networks

Much higher efficiencies than 50% have been achieved using lower temperatures. One scheme, at Lystrup in Denmark, achieved distribution losses of 17%, serving a low rise (and therefore relatively low density) development of low-energy houses (losses will always be higher in low density development because of proportionally greater lengths of pipe).[12] This scheme was an example of '4th Generation' or 4G district heating, where flow temperatures are very low compared to previous practice, at around 55C.

To minimise losses, return as well as supply temperatures should be as low as possible. High return temperatures add to distribution losses, and also impair the efficiency of the heating plant – condensing boilers can't condense so well; CHP will also be less efficient, and parasitic loads from pumping will increase, as less heat is being removed per litre pumped.

The scheme at Lystrup above achieved return temperatures of around 34C – and the engineers realised that even this carefully designed system was in fact oversized, and return temperatures could have been ▶

lower still. Hot water temperatures were not much lower than the system temperature, thanks to highly efficient heat exchangers in each house.

One concern voiced when lowering network temperatures is legionella risk. Where hot water is stored in hot water tanks or long pipe runs, it must be brought above 55C periodically. However, it is widely accepted in mainland Europe that this does not need to apply where hot water is generated instantaneously, and downstream pipe volumes are small.

German regulations for example allow up to three litres of pipe volume downstream of an instant heater. As Marko Cosic of CoHeat points out, this is the same kind of arrangement that is taken to be safe downstream of every combi boiler.[13]

In the UK and Ireland low temperature networks like this are rare, though one that appeared to work well for the users was installed at the demonstration "zero carbon" development at GreenWatt Way in Slough, UK. The small district heating system ran at 55C, with hot water taken off at 43C.

Return temperatures were between 30 and 35C, and engineer Martin Crane of Carbon Alternatives — who were responsible for the system — believes the latest equipment could lower them further. Legionella was not considered to be an issue: "There was only a very small volume of stored water, less than 1 litre," Crane explained.

The system at Agar Grove was initially designed to work at 70/40C flow and return, but the contracting team is now aiming to reduce the temperatures to 55/25C. Low volume, small bore, hot water distribution in flats will enable pipe volume downstream of instantaneous water heater to come under the three litre limit.

Commissioning

While flow temperatures are set at the plant, low return temperatures are much more difficult for a system designer to secure. As well as getting the system sizing right, they depend on the performance of the building, the design of the building services, and the behaviour of the occupants. Furthermore, return temperatures are raised disproportionately by just a few components functioning sub-optimally, so careful commissioning is key.

If heat emitters (radiators) are too small or do not give off enough heat (because for example they are insulated with towels or laundry), return temperatures will be too high. If controls do not work well – for example, bypass valves or 'heat call' valves open too often — hot water flows uselessly round the system, and return temperatures will be too high. (Bypass and/or heat call is needed to ensure the heat is always being brought near to the consumer, so they get 'instant heat')

At Agar Grove, a number of measures are being proposed to minimise return temperatures, including the smallest possible bypass, and thermostatic valves which slow down the heating flow if the water is coming back too warm. Pipe insulation will be carefully specified and, crucially, checked after installation with thermal imaging.

As the team at Agar Grove recognise, installation is as important as design — and designers need to play their part, and design for 'installability' and 'fixability'. Peter Warm advises: "Design the installation very carefully, leaving enough space for insulation, and make it accessible in case you have to go back and re-fit the insulation if it turns out to be poorly done."

After all this careful design there will, of course, still be gains from hot water distribution during the summer – these have to be taken account in the summer comfort calculations in PHPP, allowed for in the cooling provision, and in the calculations to ensure overheating limits are not breached.

Primary energy

Passive house sets a strict limit on primary energy, and all system losses have to be added in to the total. Distribution losses inside a building reduce the need for space heat in the winter, but for times of year when heating is not needed, these losses have to be added in.

With careful services design, it ought to be possible to get these heat loads low enough to be manageable both in terms of overheating risk and primary energy demand, says Alan Clarke.

However, losses outside the building may be outside the passive house designers' control.

At present, if a passive house development connects to an externally run heat grid, the primary energy entered in PHPP is derived using set loss factors for transmission and for the primary energy use by the plant.

However, the Passive House Institute recognises that this is not necessarily a good reflection of reality, and is exploring ways to make the calculation more realistic. They note however that it is very difficult, if not impossible, to get performance information (even information about lengths of heat mains) from third party district heating companies.

Can district heating deliver low bills?

While this wasted energy may not (currently) cause problems to the designer aiming for passive house certification, it still has to be paid for, and can potentially cause problems for the occupants. ▶

(below) The Agar Grove development of 350 passive house dwellings in Camden, north London, will feature a communal heating system; (opposite, top) the two biomass boilers (with chimneys) and the wood chip store (red building) supply heat to the low density development at Cloughjordan Eco-Village; (bottom) chipped offcuts from a sawmill supply heat and hot water to 55 dwellings via the village communal heating network

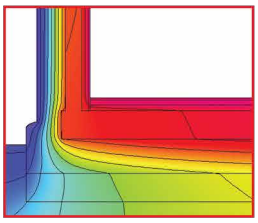


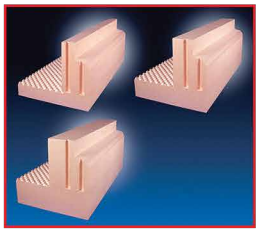
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Contrary to a lot of the claims, district heating in existing (non-passive house) developments isn't always cheap, as an online discussion reveals.[14]

One contributor reports: "The first bill I got said 'You've used 0kWh of heat' and asked me for £70. No mention was made of these charges by the housing association before people moved in, and they claim there's nothing they can do about it. We can't change supplier because the current supplier has a monopoly."

Another states: "My non-profit landlord (housing association) [promised us] bills of around £5 per week when we first moved in to our Code Level 5 eco houses.

"My hot water tariff is currently 11p/kWh… I obtained their gas bill recently and was shocked to see they are paying 3p/kWh for gas. They turn this into hot water and charge 11p/kWh to us. .. If you look at the tariffs, it's actually cheaper to use electric heaters in the winter as they cost half the price to run.

"When I question them about the high cost, all I hear is that all they are charging is what it is costing them and they insist they make no profit"

As mentioned above, as well as charging for fuel, a third party district heating scheme will have to recoup the capital investment. In Casey Cole's report on the Danish district heating system at Lystrup, he calculated that the capital cost of extending an existing network to the new houses was about £6,400 per house.

At the Cloughjordan eco village in Tipperary, Ireland, a biomass district heating system formed a central part of the plan to live communally, sustainably and with minimal fossil fuels. The system was sized and installed for 130 homes, but only 55 houses have so far been built, effectively making the system oversized at present. Duncan Martin explains: "The high fixed costs for maintenance and insurance don't go down because half the capacity isn't being used – and the heat lost into the ground doesn't go down either." What is worse, much specialist low carbon plant actually becomes less efficient when running below capacity – in some cases even having to cut out and hand over to backup boilers.

If occupants face a high fixed charge for connection to district heating – because the external losses and plant costs remain unchanged, despite their very low energy consumption, their bills will not after all be low.

Increasing the per unit cost of energy, and reducing the fixed costs, might make the scheme fairer to low-energy housing, but as Duncan Martin at Cloughjordan warns: "Folk start switching — for example, using an electric shower. Then heat sales fall, so prices have to be raised again to balance the books, and the whole thing starts to spiral down the plug-hole."

This is a worry for district heating suppliers. If they can't sell enough heat for a high enough price, they will lose money. Passive house might end up quite unpopular with district heating suppliers as a result of the ultra low heat demand. Everyone needs to be very clear at the earliest stages what the demand will be, and how the pricing will be structured.

A paper published as part of a series of investigations into European district heating systems sets it out plainly: "With third-party district heating, the low heat demand of passive house building effectively reduces the all-important energy density that is so helpful to the efficient and profitable running of district heating."[15]

Marko Cosic of CoHeat however, says that to an extent this is the system designers' own fault, and stems from systems being oversized and operated at excessively high temperatures:

"We love passive houses – they give nice flat heat load profiles throughout the season so network utilisation is excellent. Because the space heat peaks are so low you don't need the high flow temperatures that cause such problems."

Cosic also believes that charging tenants for the initial capital cost of the system through their energy bills is unreasonable; it should be seen as part of the capital cost of the development. "The connection charge should be included in the price of the property and paid by the owner," he says.

"In social housing, the model we propose is that the landlord pays for the initial capital costs out of the equivalent budget for boiler installation, and the fixed operating costs from the equivalent budget for boiler maintenance and replacement. The tenant should be paying the marginal costs – i.e. actually using the heat.

Is there an alternative?

As Bill Watts points out, the standard of CHP installation has been so poor that, "it would have been better to save the several hundreds of millions of pounds investment and use a £10 electric fan heater plugged into a 13 amp socket using grid electricity."[16]

With district heating at its worst, this would even be true in a conventionally designed home — though obviously the electricity would still be expensive. But in a passive house apartment, it would actually be very cheap. The form factor is so favourable, and space heat demand so low, that direct electric heating is feasible within the primary energy limit, according to Peter Warm.

Hot water poses a bit more of a challenge, as in passive dwellings hot water energy demand is higher than space heat, and direct electric heating of water pushes past the primary energy limit. However a heat pump sized for supplying hot water would use a lot less energy, and Warm believes the technology is worth exploring: "Exhaust air heat pumps are getting a lot better and can be as quiet as a fridge. They don't rely only on heat from the exhaust air but also draw it in from outside, so they no longer lead to over-ventilation and chilling the way the early models did."

Warm is not a fan of communal heating in passive house: "Communal fossil fuel systems can work for old buildings, listed buildings... but in a modern passive house I feel it's wasteful, and the buildings are always too hot." In Warm's view, the drive for communal heating risks distorting decision-making about low energy building, which is having to bend around in the service of a particular system, rather than simply pick what works best for the buildings. "The tail is wagging the dog," he feels.

With his experience of purchasing and running district heating plant for low heat loads, Duncan Martin of Cloughjordan Eco Village can see that capital intensive energy systems and high-specification low energy housing aren't necessarily natural bedfellows. "The extra investment of passive house when you have to pay the standing charge for district heating, and the heat is cheap, makes it a bit questionable whether it is worth it."

And looking at it the other way, now that passive house is becoming more widespread and familiar, Duncan Martin wonders whether for a similar eco-community, district heating would still be a logical choice.

Yet it is still low carbon heat that attracts the financial inducements, in subsidies such as the Renewable Heat Incentive. And it is even suggested that with district heating, there is less justification for the refinements in energy saving delivered by passive house, as "low carbon heat" is supposedly a simpler or cheaper way to decarbonise.

Mechanical ventilation with heat recovery [MVHR] in particular has been singled out as a more expensive form of carbon abatement than district heating. In one of the case studies looked at by Innovate, the consulting engineer stated that "one of the other reasons for using MEV [mechanical extract ventilation] rather than MVHR was to concentrate on maximising efficiency from the district heating network." Yet the district heating system on this development had so many issues with the plant that it ended up using more fuel than individual condensing boilers would — in fact in the early stages of the scheme, the amount was double.

There are many questions about the current reliability of "low carbon" heat and its true carbon footprint.[17] One can question too whether major new sources will really materialise in future.[18] By contrast, with passive house, the technology to slash carbon and energy use is available now.

Passive house is not just about saving energy; it is, equally, about healthy and comfortable living conditions. The need to satisfy a desire for the potential benefits of low carbon heat should not be allowed to detract from the actual benefits passive house offers to occupants.

Losses of 60% make no kind of sense in a world where energy is precious — low carbon energy, especially so. Even losses of 30% only make sense if there is a reliable source of genuinely low carbon heat that simply cannot be operated closer to the customers' buildings.

As designs, technologies and installation standards are refined, district and communal heating may one day serve low energy housing as easily, simply and efficiently as the simple condensing gas boiler — and may even be able to offer carbon savings. In the meantime, it might be a mistake to let the tail wag the dog.



Passive house *or equivalent*

The meaning behind a ground-breaking policy

Dún Laoghaire-Rathdown's passive house policy also leaves the door open for alternative approaches, provided their equivalence can be demonstrated. But what does this mean?

Words: Jeff Colley

On 17 February Dún Laoghaire-Rathdown County Council – one of the four local authorities in the Dublin region – voted to adopt its new county development plan, including an historic commitment on low energy building. The councillors passed a motion that I had the honour of wording which means that all new buildings in the county – not only all new dwellings, but all new buildings in general – must be built to the passive house standard or demonstrably equivalent performance levels. The implications of this are profound.

Consider for a moment how many buildings this policy will effect. The development plan take its lead from the Regional Planning Guidelines for the Greater Dublin Area (2010-2022), which set housing allocations for the region. The plan signals an allocation of 30,885 dwellings to be built from 2014 to 2022 – a rate of 3,800 units per year. Remarkably little was built in 2014 and 2015 as the construction industry – and property developers in particular – struggled to keep pace with a recovering economy. Nonetheless, such is the growing recognition and political consensus of the need to build our way out of an escalating housing crisis, we should expect to see a significant growth in construction output. The council is certainly planning with that in mind, and has calculated the number of new homes that could be built on either serviced or unserviced land within the lifespan of the plan. One area, Cherrywood, is a strategic development zone, which makes it legally discrete from the provisions of the development plan, meaning its allocation of up to 7,700 homes won't be subject to the development plan's requirements. That said, its developers, Hines, would be wise to consider applying the passive house standard, or a genuinely equivalent alternative throughout the new development. Several articles published in Passive House Plus over the years – including the Michael Bennett & Sons scheme featured in this issue – have demonstrated that passive houses can be built for little or no increase in construction costs. That being the case, why would any developer build to a lower standard than neighbouring developments? Leaving Cherrywood aside, it seems reasonable to estimate that this policy could apply to the construction of upwards of 20,000 new homes, as well as a proportionate number of new non-residential buildings. No target amount for non-residential buildings is specified in the plan, but it can be safely read to be in the hundreds of thousands of square metres worth of space.

Let's start with the wording itself. The wording I prepared – and seeing it in print in the published county development plan is still a shock – is as follows:

> *All new buildings will be required to meet the passive house standard or equivalent, where reasonably practicable. By equivalent we mean approaches supported by robust evidence (such as monitoring studies) to demonstrate their efficacy, with particular regard to indoor air quality, energy performance, comfort, and the prevention of surface/interstitial condensation. Buildings specifically exempted from BER ratings as set out in S.I. No. 666 of 2006 are also exempted from the requirements of Policy CC7. These requirements are in addition to the statutory requirement to comply fully with Parts A-M of Building Regulations.*

But what does this mean? While I worded the policy, it will ultimately fall upon the planners to interpret its meaning, and apply it with regard to planning applicants. So it's important to bear in mind that what follows is my interpretation of a policy whose meaning is in my view, unambiguous.

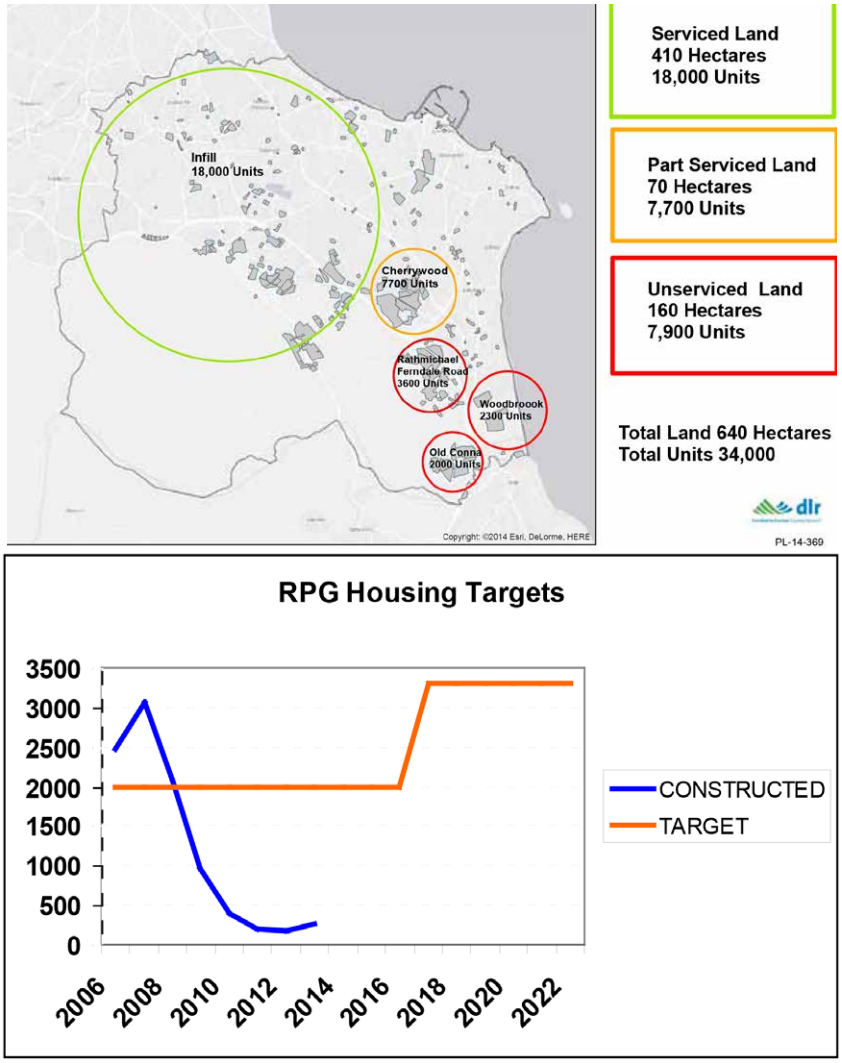
The "reasonably practicable" clause has already generated a fair amount of discussion, but it's uncontroversial. It's actually taken from Part L of the building regulations – specifically Part L1, the regulation's main requirement, which states thus: "A building shall be designed and constructed so as to ensure that the energy

performance of the building is such as to limit the amount of energy required for the operation of the building and the amount of carbon dioxide (CO_2) emissions associated with this energy use insofar as is reasonably practicable." The phrase is also in widespread in local authority planning requirements with regard to drainage and preventing flooding risk.

While the plan refers to the passive house standard or equivalent, it then goes on to define that equivalence must be demonstrated not only in terms of energy performance, but indoor air quality, comfort and condensation risk. It explains how this equivalence is to be demonstrated, by demanding that approaches other than passive house be "supported by robust evidence (such as monitoring studies) to demonstrate their efficacy." The reference to monitoring studies is very deliberate. Theoretical figures in guidance documents, codes of practice and software applications are worse than useless if they haven't been calibrated against the real buildings to which they're intended to apply. That's not to doubt the critical important of theoretical tools. It's rather to say theory needs to be demonstrated in studies of real buildings, with an ongoing feedback process so that information gleaned from monitoring studies informs the theory, and so on.

I mentioned indoor air quality first in the wording, before energy performance, for a reason: it has been neglected for far too long across the industry, and across society. Many people don't see the sense in insulating a building, only to deliberately replace the air you've worked hard to make warm with cold air. And as a University of Exeter study on several hundred dwellings found , homes with higher Energy Performance Certificate scores were associated with statistically significant increases in doctor-diagnosed asthma cases. The highest rated homes in that study had a B rating on the UK's scale.

Data from SEAI's National BER Research Tool – a creditable example of open government, a database filled with every published Building Energy Rating for Irish dwellings – shows that the average new home in Ireland built since the current energy performance standards kicked in is hitting a mid-A3 Building Energy Rating, and a calculated score of 60 kWh/m^2/yr. Most worryingly, 66% of these new homes are reliant on natural ventilation – either holes drilled in walls or trickle vents in window frames, plus intermittent fans in bathrooms and kitchens. The consensus across the industry is that such an approach doesn't work, and that this is bound to lead to significant problems in low energy buildings. These naturally ventilated homes are hitting an average airtightness of 4.08 m^3/mhr/m^2 at 50 Pa. Part F of the building regulations, which addresses ventilation, attempts a solution of sorts: a requirement that in buildings with an air permeability of 5m^3/hr/m^2 at 50 Pa or lower, the equivalent area of vents must be increased by 40%. Not only is there no apparent evidential basis for the efficacy of this general approach to ventilation, a monitoring study for the UK government on typical natural ventilation "systems" in 22 homes found that occupants had actually blocked 60% of vents - a perhaps unsurprising consequence of providing people with ventilation systems that – during the times when they actually ventilate – introduce cold air and create discomfort. And anecdotal feedback



Extracts from Dún Laoghaire-Rathdown's new county development plan give a sense of the quantity of housing that the council aims to see being built within the lifespan of the plan, and a sobering reminder of how low construction output has been in the area in the long hangover after the property crash; (p77, top) a UK monitoring study on typical natural ventilation "systems" in 22 homes found that occupants had blocked 60% of vents, (p77, bottom) the 2005 Energy Performance Survey of Irish Housing contained alarming evidence of growing disparity between theoretical and actual energy use in newer homes

from major players in the Irish insulation and ventilation sectors has been that the Part F requirement to add 40% more holes is being routinely ignored in the overwhelming majority of cases.

Unless supported by robust evidence such as monitoring studies to prove equivalence to passive house in terms of energy, indoor air quality, comfort and condensation, the government's mooted nearly zero energy building (NZEB) definition will fail this equivalence test. All EU member states must produce such a definition and apply it for all new buildings by 2021 thanks to a requirement of the recast EU Directive on the Energy Performance of Buildings. This is not to entertain the nightmarish fiction that Dún Laoghaire-Rathdown will be annexed by a post-Brexit UK, and therefore can set its own building standards while ignoring EU diktat. New buildings built in Dún Laoghaire-Rathdown will of course have to satisfy the national NZEB requirement. But unless the NZEB definition and other relevant parts of building regulations are tightened up to pass the equivalence test, it will be the case that only certain approaches to NZEB may pass muster. For instance, take indoor air quality again. While robust evidence – including monitoring studies – does exist to demonstrate that forms of mechanical ventilation other than MVHR can be effective in dwellings, the same cannot be said of typical natural ventilation. Similarly, there appears to be a paucity of credible data to support the claim of passive stack ventilation, without mechanical back up to kick-in when necessary. In certain weather conditions – such as still, warm days, where there's neither the wind nor the temperature difference to create the buoyancy to drive the stack effect – it simply won't work.

Comfort is another area where where other approaches, such as current Part L or NZEB may struggle to demonstrate equivalence. By comfort we mean thermal comfort specifically, taking account of minimum and maximum temperatures. As passive house certifier Tomas O'Leary has argued in these pages before, the temperature assumptions in Ireland's national calculation methodology, Deap – 21C in living areas and 18C in all other areas – translates in a typical semi-D, where the living area fraction is circa 15%, to about 18.5C for the whole house. That compares to a whole house temperature of 20C in the Passive House Planning Package. And that's not all: Deap is assuming that semi-D is heated to 18.5C during the heating season, but only for eight hours a day – raising the question: how low might the temperatures drop during the unheated 16 hours. The 20C temperature in PHPP is 24 ▶



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hours a day. In terms of minimum temperatures, it's plainly obvious that Deap will assume a less comfortable building than PHPP.

But comfort also takes into account maximum temperatures. Overheating can be a significant risk in low energy buildings – a risk that may increase substantially during the lifetime of new buildings, due to the impacts of climate change – and this is especially so if it's not considered as part of the design process. Overheating isn't referenced in the guidance associated with Part L requirements for dwellings, in spite of how far the energy performance requirements have progressed. However it does feature in the 2008 technical guidance document L for buildings other than dwellings, albeit specifically with regard to passive solar gains, as per the following extract:

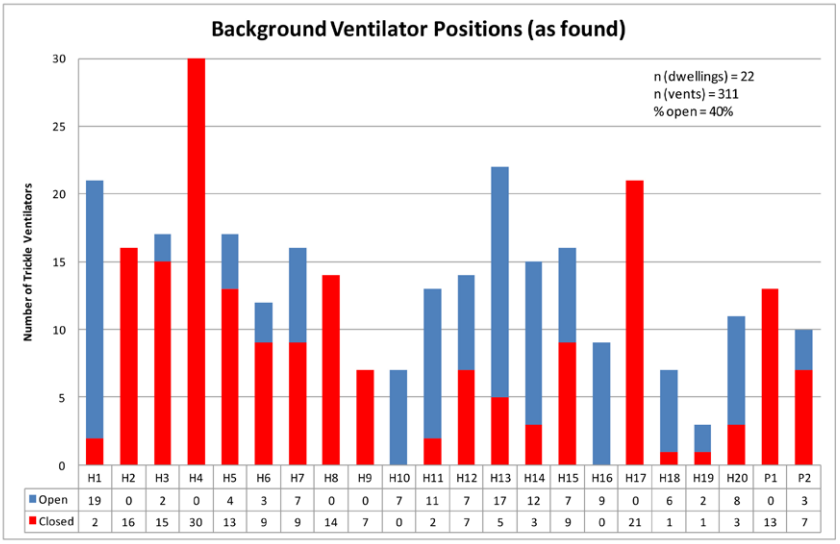
> *Buildings should be designed and constructed so that:*
> *(a) those occupied spaces that rely on natural ventilation do not risk unacceptable levels of thermal discomfort due to overheating caused by solar gain, and*
> *(b) those spaces that incorporate mechanical ventilation or cooling do not require excessive plant capacity to maintain the desired space conditions*

Note the reference to naturally ventilated buildings suffering overheating risk by solar gains. How many of the 66% of naturally ventilated new homes in Ireland – which are highly insulated, moderately airtight buildings that should be relatively slow to lose heat – also include substantial south facing glazing?

The reality is that the overheating risk in low energy buildings is not merely due to solar gains. It's also about internal gains from appliances, occupants and building services. The passive house sets a target that maximum calculated temperatures must not exceed 25C for more than 10% of the year, though many passive house designers aim for as little as zero percent.

Energy performance

Then there's energy performance. Unfortunately we don't know how homes or non-residential buildings built to Part L are actually performing, because the requisite monitoring studies haven't been done. In fact the only such study to check the actual energy performance of a representative sample of the Irish housing stock – the 2005 Energy Performance Survey of Irish Housing, which remains unpublished, but which SEAI agreed to release to me in 2011 – included an alarming finding in this regard. The 150 homes in the study were divided up by age band, with two to three years worth of actual purchased heat energy inputted and compared against the calculated usage in a modified version of the Heat Energy Rating (HERm) tool, a precursor to Deap. This led to a remarkable finding: actual purchased heat energy use was getting progressively lower in each newer age band as expected, with the exception of the newest homes in the sample, which were built post-1997 improvements to insulation standards, but which nonetheless registered a 16% increase in purchased energy use (whereas the HERm showed a projected 3% increase, which the report explains is within the margin of error, and "can be attributed to the changing mix of built form types between the two periods.") The report also noted that while the theoretical heat energy use of the post-1997 homes was 41% lower than the pre 1981 baseline, the purchased heat energy was a mere 13% lower than that baseline, adding that: "There is also a trend of increasing difference between theoretical and actual heat energy consumption in newer housing."



	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12	H13	H14	H15	H16	H17	H18	H19	H20	P1	P2
Open	19	0	2	0	4	3	7	0	0	7	11	7	17	12	7	9	0	6	2	8	0	3
Closed	2	16	15	30	13	9	9	14	7	0	2	7	5	3	9	0	21	1	1	3	13	7

This study, which included other alarming findings with regard to endemic non-compliance with building regulations, and either missing insulation or cold bridging problems in 19 of 20 homes subjected to deeper analysis, was never published. Nor did it lead to follow-up studies to check whether some of the worrying trends and non compliance issues worsened or improved as the construction boom advanced and, eventually, crashed, and as ambitious new energy performance standards were introduced for homes in 2008 and 2011. The only data we have – as per this study – indicates a widening gap between theoretical and actual heat energy use. I don't doubt that standards of workmanship have improved in Irish construction recently with regard to energy performance. That's borne out by the fact that the average airtightness test result for new homes has improved significantly from the average of 11.8 $m^3/hr/m^2$ at 50 Pa for the 28 post-1997 homes in the Energy Performance Survey of Irish Housing that were subjected to airtightness tests, to 3.6 $m^3/hr/m^2$. But the point remains: the only evidence we have that included actual energy use of a representative sample of Irish homes shows a substantial and widening gap between calculated and actual energy use. It's impossible to say whether homes built to 2011 Part L will perform close to the calculations, and we're equally in the dark about NZEB. The evidence shows that passive houses on the other hand, as identified in numerous monitoring studies, tend to perform remarkably close to their calculated levels – a fact that's all the more remarkable given that their calculated space heating use is so low.

It remains to be seen what approaches other than the passive house standard pass the equivalence test for the planners in Dún Laoghaire-Rathdown. The insertion of the "or equivalent" clause was not a tokenistic reference on my part. Frankly I don't care whether people build to the passive house standard or not. For me it's rather a matter of ensuring that new buildings are built to achieve equivalent performance levels as passive house under a range of key indicators – both for the sake of the occupants and the environment, and to ensure that Ireland doesn't waste money attempting to solve the housing crisis by building uncomfortable, wasteful, unhealthy buildings.

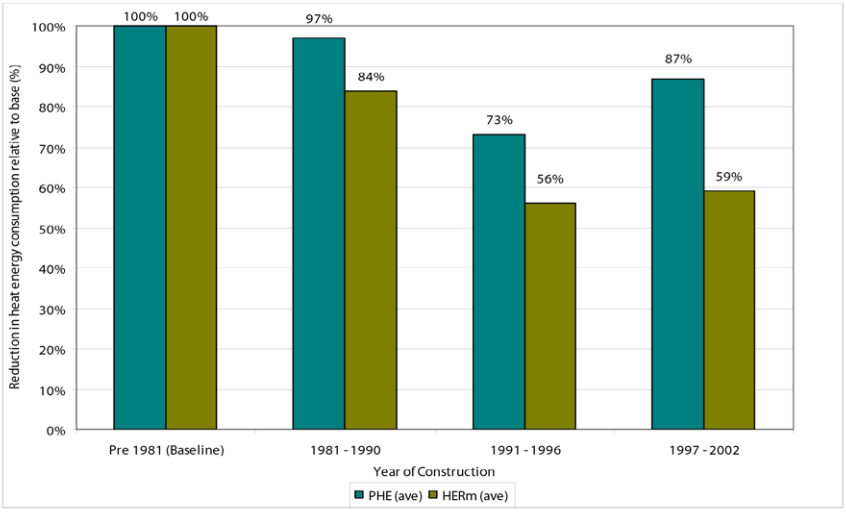


Figure 3.11 - Reduction in heat energy consumption, relative to base of 1961 - 1980, by year of construction

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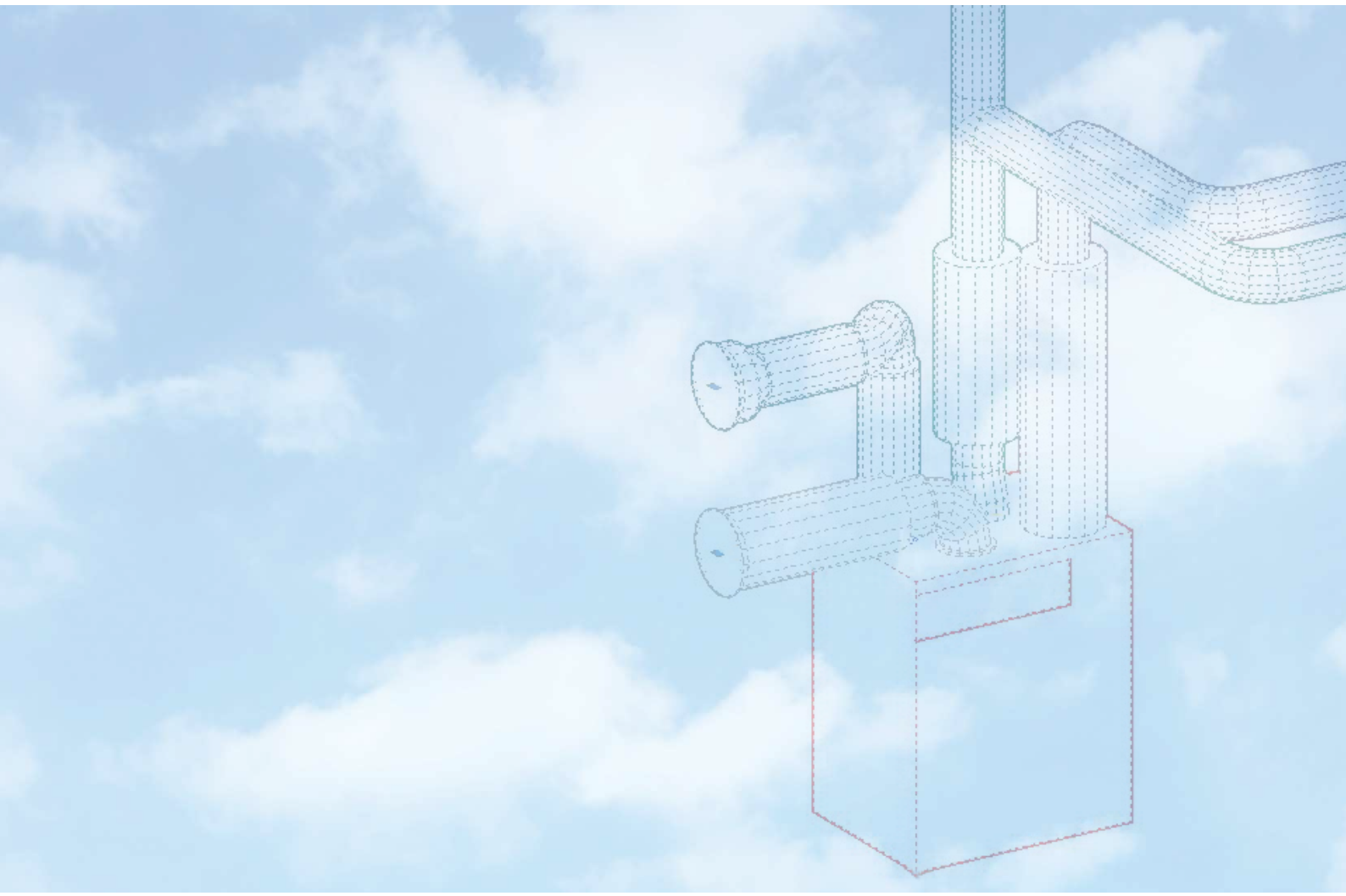
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